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# Principles of Finance

# Principles of Finance

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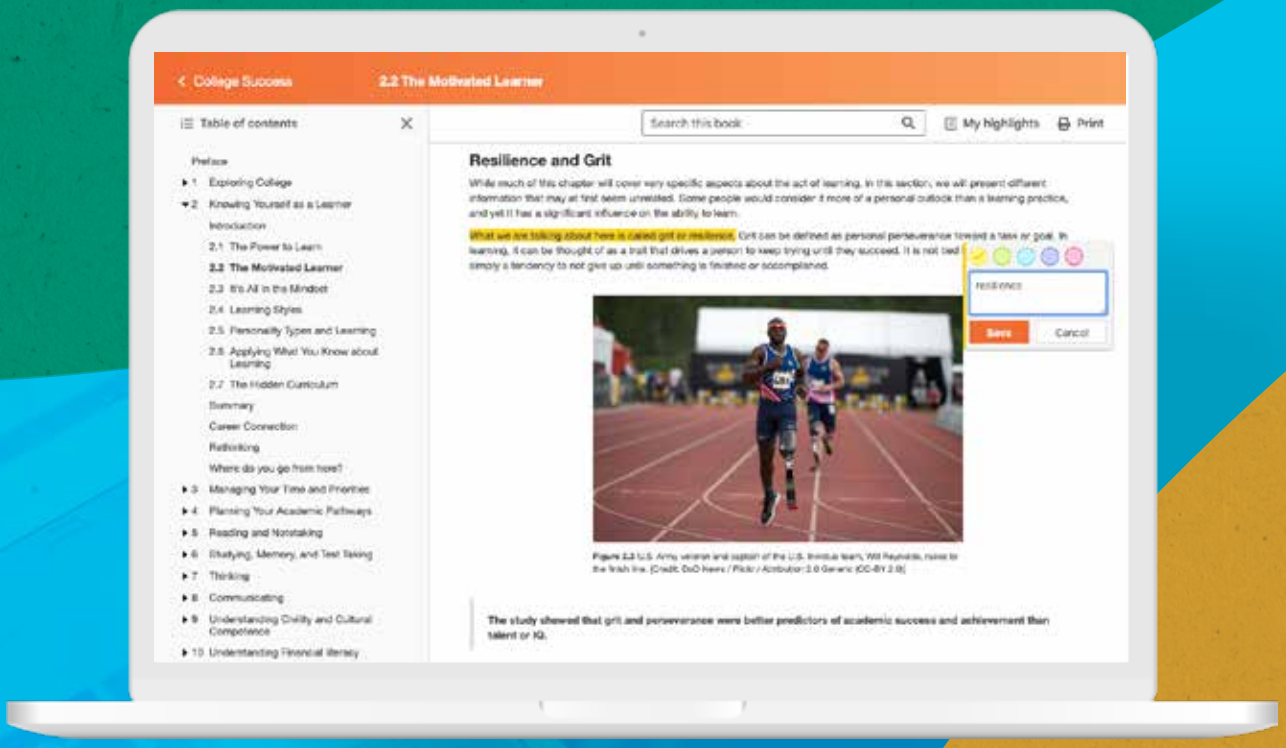


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# Preface

## About OpenStax

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## About *Principles of Finance*

### Summary

*Principles of Finance* is targeted at the core finance course for undergraduate business majors. The book is designed for conceptual accessibility to students who are relatively early in their business curriculum (such as second-year students), yet it is also suitable for more advanced students. Due to the wide range of audiences

and course approaches, the book is designed to be as flexible as possible. Its modular structure allows the introduction and review of content from prerequisite subjects in financial accounting, statistics, and economics, depending on student preparation. It provides a solid grounding in the core concepts of financial theory so that business students interested in a major or minor in finance will also be prepared for more rigorous upper-level courses. Concepts are further reinforced through applicable connections and practical calculation techniques for more detailed and realistic company scenarios from various industries.

## Pedagogical Foundation

*Principles of Finance* emphasizes financial concepts relevant to people working in a variety of business functions. To illuminate the meaningful applications and implications of financial ideas, the book incorporates a unique use-case approach, providing connections among topics, solutions, and real-world problems. This multifaceted framework drives the integration of concepts while maintaining a modular chapter structure. Theoretical and practical aspects are presented in a balanced manner, and select ethical considerations are introduced, particularly in the context of corporate governance.

In order to create meaning for all students, *Principles of Finance* exposes them to a range of companies, industries, and scenarios reflecting different contexts. Examples of large companies such as Apple, Peloton, and American Airlines are balanced with small businesses—coffee shops, clothing stores, and salons—that may be more aligned with student experiences. The text includes authentic narratives from corporate finance, small business, and personal finance to drive relevance and interest of the discipline. Profiles and interviews include diverse figures in finance, such as Carlos Slim, Irina Simmons, Janet Yellen, and Ben Bernanke. Problems and exercises have been carefully constructed to place students into a range of settings and contexts as they develop knowledge and put it into practice. Finally, to reflect very recent experiences, the authors have incorporated several discussions regarding the COVID-19 pandemic and its impact on people and businesses.

Throughout, there is an emphasis on data use in business decision-making, with integrative sections on the importance and analysis of financial, economic, and statistical data. Data types include FRED (https://openstax.org/r/fred-stlouisfed)® economic data, company financial statements, and stock prices. Practical techniques and calculation examples for data analysis with financial calculators (the Texas Instruments BA II Plus™ Professional model is used as the basis for example illustrations) and/or spreadsheets are included for relevant topics. For key chapters, downloadable Microsoft® Excel® data files are available for student reference. This technical feature provides students with access to the Excel data files used in the chapter examples for time value of money (Chapters 7, 8, 9) and statistics (Chapters 14, 15, 16) problems. The downloadable files for the chapters covering financial forecasting and trade credit (18 and 19) allow students to see how changing assumptions and variables impact financial decision-making. Chapters 13 and 14 (statistical and regression analysis, respectively) also include brief sections about the R software (https://openstax.org/r/r-software) package to promote further interest in trends in data science.

## Teaching Plan Options

*Principles of Finance* includes chapters on basic, applied, and integrative finance topics as well as key concepts from prerequisite financial accounting, quantitative methods (statistics), and economics courses. The chapters on prerequisite topics highlight examples relevant to finance students. For instructors with a limited one-semester schedule or whose students have solid knowledge of prerequisite disciplines, we recommend focusing on the “core” chapters, as indicated in the following table of contents:

| | | |
|---|---|---|
| 1 | Introduction to Finance | Core |
| 2 | Corporate Structure and Governance | Core |
| 3 | Economic Foundations: Money and Rates | Extension |

**Table 1**

| | | |
|---|---|---|
| 4 | Accrual Accounting Process | Extension |
| 5 | Financial Statements | Core |
| 6 | Measures of Financial Health | Core |
| 7 | Time Value of Money I: Single Payment Value | Core |
| 8 | Time Value of Money II: Equal Multiple Payments | Core |
| 9 | Time Value of Money III: Unequal Multiple Payment Values | Core |
| 10 | Bonds and Bond Valuation | Core |
| 11 | Stocks and Stock Valuation | Core |
| 12 | Historical Performance of US Markets | Core |
| 13 | Statistical Analysis in Finance | Extension |
| 14 | Regression Analysis in Finance | Extension |
| 15 | How to Think about Investing | Core |
| 16 | How Companies Think about Investing | Core |
| 17 | How Firms Raise Capital | Core |
| 18 | Financial Forecasting | Core |
| 19 | The Importance of Trade Credit and Working Capital in Planning | Extension |
| 20 | Risk Management and the Financial Manager | Extension |

**Table 1**

Although chapters are written to be independent, they do generally build on the understanding in the previous core chapters. Please bear this in mind when considering alternate sequences.

## Key Features to Drive Understanding

- **Concepts in Practice** presents examples of financial challenges, managerial decisions, and the range of accepted business practice in companies and industries.
- **Think It Through** guides students through the process of applying the concepts in the chapter to analyzing and interpreting data.
- **Link to Learning** introduces students to online resources (further reading, data sources, or videos) that are pertinent to students' exploration of the topic at hand.

## Organizational and Reinforcement Materials to Support Learning

- **Learning Outcomes.** Every section begins with a set of clear and concise learning outcomes (LOs). These outcomes are designed to help the instructor decide what content to include or assign and to guide students on what they can expect to learn.
- **Why It Matters.** Chapter opening examples include real-world topics from corporate finance, small business, and personal finance to explain the relevance and interest of the topic for students.
- **CFA® Institute.** For certain chapters, a topical connection to the learning outcome statements (LOS) for the Level I Study Sessions (https://openstax.org/r/level1-study-session) of the CFA Institute's professional curriculum is indicated at the end of the chapter.
- **Summaries.** Designed to support both students and instructors, chapter summaries distill the information in each section down to key, concise points.
- **Key Terms.** Key terms are bold and are followed by an explanation in context. Definitions of key terms are also listed in a glossary that appears at the end of each module online and at the end of each chapter in print.
- **Assessments.** A mix of multiple-choice questions, short-answer review questions, and quantitative

problems is provided, depending on topic, providing opportunities for students to recall, discuss, and examine the concepts learned in each chapter.
  - **Multiple-choice questions** are basic review questions that test comprehension.
  - **Short-answer questions** are brief open-response questions that allow the application of concepts or critical thinking.
  - **Quantitative problems** range from single-variable to multistep or multivariable calculations, depending on the difficulty and application level of the chapter.
  - **Sample answers and solutions** are provided as part of the instructor resources.

- **Video Activity.** This optional interactive activity at the end of every chapter provides reflection questions for students to apply to two online YouTube videos that offer a variety of corporate, economic, government, and skills-based examples and perspectives.

# About the Authors

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Dr. Dahlquist is a professor of professional practice in the Finance Department of the Neeley School of Business at Texas Christian University. She holds a PhD from Texas A&M University, an MA from St. Mary's University, a BBA from the University of Louisiana at Monroe, and a Chartered Market Technician® (CMT) designation. Previously, she served on the finance faculties of the University of Texas at San Antonio and St. Mary's University. She has extensive international experience teaching finance to undergraduate, graduate, and executive MBA students in programs in Mexico, Austria, Germany, Switzerland, Italy, Belgium, Greece, and South Korea. Dr. Dahlquist is president of the Technical Analysis Educational Foundation (TAEF), which works with universities to include technical analysis as an integral part of their finance curricula. She has coauthored *Technical Analysis: The Complete Resource for Financial Market Technicians* (with Charles Kirkpatrick, 3rd edition, FT Press, 2015) and has contributed to many other scholarly publications. Her research has appeared in *Financial Analysts Journal*, *Managerial Finance*, *Applied Economics*, *Working Money*, *Financial Practices and Education*, and the *Journal of Financial Education*. Dr. Dahlquist has served as editor of the *Journal of Technical Analysis*, a member of the editorial board of the *Southwestern Business Administration Journal*, and a reviewer for several other journals.

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1

# Introduction to Finance

**Figure 1.1** Finance is the linchpin that connects and directs many parts of a business or organization. (credit: modification of work "Finance behind the Glass" by Max London/flickr, CC BY 2.0)

## Chapter Outline


**1.1** What Is Finance?
**1.2** The Role of Finance in an Organization
**1.3** Importance of Data and Technology
**1.4** Careers in Finance
**1.5** Markets and Participants
**1.6** Microeconomic and Macroeconomic Matters
**1.7** Financial Instruments
**1.8** Concepts of Time and Value


## Why It Matters

Finance is essential to the management of a business or organization. Without good financial protocol, safeguards, and tools, running a successful business is more difficult. In 1978, Bacon Signs was a family-owned, regional Midwestern sign company engaged in the manufacture, sale, installation, and maintenance of commercial signage. The company was about to transition from the second to third generation of family ownership. Bacon Signs, established in 1901, had weathered the Great Depression, World War II, the Vietnam War, and the oil embargo and was working its way through historically high rates of inflation and interest rates. The family business had successfully struggled through the ebb and flow of the regional and national economy by providing quality products and service to its regional clients.

In the early 1980s, the company's fortunes changed permanently for the better. The owner recognized that the custom signs built by his firm were superior in quality to the signs it installed for national franchises. The owner worked with the company's banker and vice president of finance and operations to develop a production, sales, and financing plan that could be offered to the larger national sign companies. The larger companies agreed to subcontract manufacturing of midsize orders to Bacon Signs. The firm then made a commitment to build and deliver these signs on time and under budget. As Bacon Signs' reputation for quality grew, so did demand for its products. The original financing plan anticipated this potential growth and was

designed to meet anticipated capital requirements so that the firm could expand how and when it needed to.

Bacon Signs' ability to manufacture and deliver a high-quality product at a good price was the true value of the firm. However, without the planning and ability to raise capital facilitated by the financing plan, the firm would not have been able to act on its strengths at the critical moment. Financing was the key to expansion and financial stability for the firm.[1]

In this book, we demonstrate that business finance is about developing and understanding the tools that help people make consistently good and repeatable decisions.

# 1.1 What Is Finance?

## Learning Outcomes

By the end of this section, you will be able to:

- Describe the main areas in finance.
- Explain the importance of studying finance.
- Discuss the concepts of risk and return.

## Definition of Finance

Finance is the study of the management, movement, and raising of money. The word *finance* can be used as a verb, such as when the First National Bank agrees to finance your home mortgage loan. It can also be used as a noun referring to an entire industry. At its essence, the study of finance is about understanding the uses and sources of cash, as well as the concept of risk-reward trade-off. Finance is also a tool that can help us be better decision makers.

## Basic Areas in Finance

Finance is divided into three primary areas in the domestic market: business finance, investments, and financial markets and institutions (see Figure 1.2). We look at each here in turn.

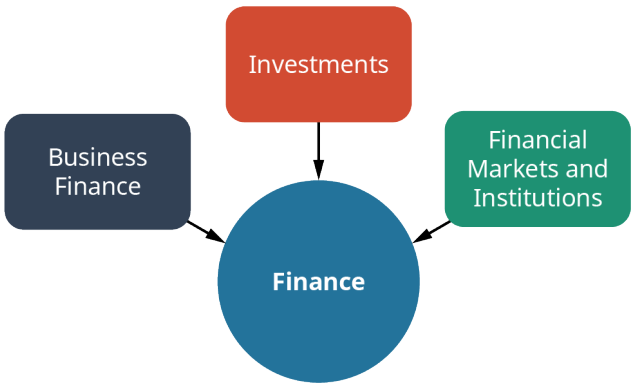


**Figure 1.2 The Three Basic Areas of Study in Finance**

### Business Finance

**Business finance** looks at how managers can apply financial principles to maximize the value of a firm in a risky environment. Businesses have many stakeholders. In the case of corporations, the shareholders own the company, and they hire managers to run the company with the intent to maximize shareholder wealth. Consequently, all management decisions should run through the filter of these questions: "How does this decision impact the wealth of the shareholders?" and "Is this the best decision to be made for shareholders?"

In business finance, managers focus on three broad areas (see Figure 1.3).

1 Dun & Bradstreet. "Bacon Signs, Inc." *D&B Business Directory.* https://www.dnb.com/business-directory/company-profiles.bacon_signs_inc.90df737e33956dd7c76717a20e9d56ad.html#financials-anchor

1. **Working capital management** (WCM) is the study and management of short-term assets and liabilities. The chief financial officer (CFO) and the finance team are responsible for establishing company policy for how to manage WCM. The finance department determines credit policy, establishes minimum criteria for the extension of credit to clients, terms of lending, when to extend, and when to take advantage of short-term creditor financing. The accounting department basically implements the finance department's policies. In many firms, the accounting and finance functions operate in the same department; in others, they are separate.
2. **Capital budgeting** is the process of determining which long-term or fixed assets to acquire in an effort to maximize shareholder value. Capital budgeting decisions add the greatest value to a firm. As such, capital budgeting is thought to be one of the most important financial functions within a firm. The capital budgeting process consists of estimating the value of potential investments by forecasting the size, timing, and risk of cash flows associated with the investments. The finance department develops and compiles cash flow estimates with input from the marketing, operations, accounting, human resources, and economics departments to develop a portfolio of investment projects that collectively maximize the value of the firm.
3. **Capital structure** is the process by which managers focus more specifically on long-term debt and increasing shareholder wealth. Capital structure questions require financial managers to work with economists, lenders, underwriters, investment bankers, and other sources of external financial information and financial capital. When Bacon Signs developed its financial plan, the executives included each of these three aspects of business finance into the plan.

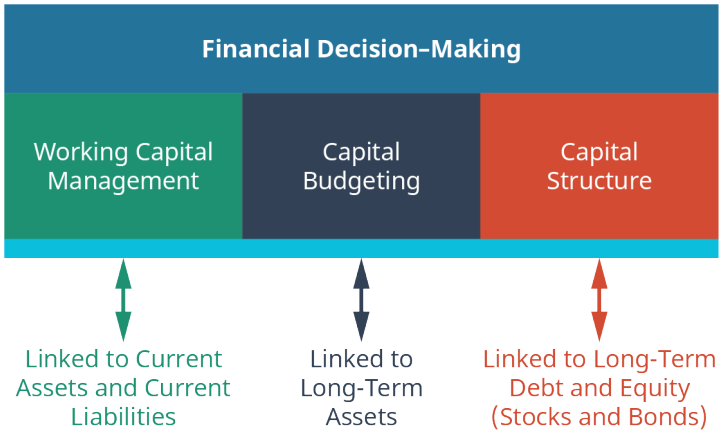


**Figure 1.3 How Corporate Finance Decision-Making Activities Relate to the Balance Sheet**

Figure 1.3 demonstrates how the three essential decision-making activities of the financial manager are related to a balance sheet. Working capital management focuses on short-term assets and liabilities, capital budgeting is focused on long-term assets, and capital structure is concerned with the mix of long-term debt and equity financing.

## Investments

**Investments** are products and processes used to create and grow wealth. Most commonly, investment topics include the discussion and application of the different types of financial instruments, delivery vehicles, regulation, and risk-and-return opportunities. Topics also include a discussion of stocks, bonds, and derivative securities such as futures and options. A broad coverage of investment instruments would include mutual funds, exchange-traded funds (ETFs), and investment vehicles such as 401k plans or individual retirement accounts (IRAs). In addition, real assets such as gold, real estate, and commodities are also common discussion topics and investment opportunities.

Investments is the most interesting area of finance for many students. Television programs such as *Billions* and movies such as *Wall Street* make investing appear glamorous, dangerous, shady, or intoxicating,

depending on the situation and the attitude of the viewer. In these programs, the players and their decisions can lead to tremendous wealth or tremendous losses. In reality, most of us will manage our portfolios well shy of the extremes portrayed by the entertainment industry. However, we will need to make personal and business investment decisions, and many students reading this material will work in the investment industry as personal investment advisers, investment analysts, or portfolio managers.

## Financial Markets and Institutions

**Financial markets and institutions** are the firms and regulatory agencies that oversee our financial system. There is overlap in this area with investments and business finance, as the firms involved are profit seeking and need good financial management. They also are commonly the firms that facilitate investment practices in our economy. A financial institution regulated by a federal or state agency will likely handle an individual investment such as the purchase of a stock or mutual fund.

Much of the US regulatory structure for financial markets and institutions developed in the 1930s as a response to the stock market crash of 1929 and the subsequent Great Depression. In the United States, the desire for safety and protection of investors and the financial industry led to the development of many of our primary regulatory agencies and financial regulations. The Securities and Exchange Commission (SEC) was formed with the passage of the Securities Act of 1933 and Securities Exchange Act of 1934. Major bank regulation in the form of the Glass-Steagall Act (1933) and the Banking Act of 1935 gave rise to government-backed bank deposit insurance and a more robust Federal Reserve Bank.

These regulatory acts separated investment banking from commercial banking. Investment banks and investment companies continued to underwrite and facilitate new bond and equity issues, provide financial advice, and manage mutual funds. Commercial banks and other depository institutions such as savings and loans and credit unions left the equity markets and reduced their loan portfolios to commercial and personal lending but could purchase insurance for their primary sources of funds, checking, and savings deposits.

Today, the finance industry barely resembles the structure your parents and grandparents grew up and/or worked in. Forty years of deregulation have reshaped the industry. Investment and commercial bank operations and firms have merged. The separation of activities between investment and commercial banking has narrowed or been eliminated. Competition from financial firms abroad has increased, and the US financial system, firms, and regulators have learned to adapt, change, and innovate to continue to compete, grow, and prosper.

The **Financial Industry Regulatory Authority (FINRA)** formed in 2007 to consolidate and replace existing regulatory bodies. FINRA is an independent, nongovernmental organization that writes and enforces the rules governing registered brokers and broker-dealer firms in the United States. The **Securities Investor Protection Corporation (SIPC)** is a nonprofit corporation created by an act of Congress to protect the clients of brokerage firms that declare bankruptcy. SIPC is an insurance that provides brokerage customers up to $500,000 coverage for cash and securities held by the firm.

The regulation of the financial industry kicked into high gear in the 1930s and for those times and conditions was a necessary development of our financial industry and regulatory oversight. Deregulation of the finance industry beginning in the 1970s was a necessary pendulum swing in the opposite direction toward more market-based and less restrictive regulation and oversight. The Great Recession of 2007–2009 resulted in the reregulation of several aspects of the financial industry. Some would argue that the regulatory pendulum has swung too far toward deregulation and that the time for more or smarter regulation has returned.

CONCEPTS IN PRACTICE

### The Great Recession

The Great Recession of 2007–2009 exposed many of the weaknesses of our financial system. The ease with which banks could lower credit standards to allow ill-prepared consumers to purchase real estate and the resulting speed with which the world economy plunged into recession is astounding.

Regulation to address the economic crisis was also swift. Fortunately, Ben Bernanke, chairman of the Federal Reserve at the time, had throughout his career conducted extensive research into the causes of and potential resolution of the Great Depression of the 1930s.[2] He was uniquely qualified to lead the economic response to the crisis. Some resulting laws moved to address the immediate needs and others to correct the underlying causes of the recession.

One immediate fix was the Troubled Asset Relief Program (TARP). TARP authorized the Treasury to buy illiquid assets in order to save the financial institutions so important to lubricating our economy. Politically this was a tough decision, as it appeared that the government bailed out greedy bankers. In the end, however, the program was justified because the economy immediately began a slow but steady recovery, most financial institutions did not fail, and the Treasury recouped all of its investment used in the bailout. However, individual homeowners suffered greatly.

The Dodd-Frank Act of 2008 attempted to address many of the underlying causes of the Great Recession by reorganizing and toughening the regulatory framework, including tighter oversight of critically important financial institutions. Dodd-Frank also created the Consumer Financial Protection Bureau (CFPB) to protect consumers from harm caused by unscrupulous banking activities. Today, the hope is that financial institutions will be stopped short of the gross negligence evident prior to 2007 and consumers won't be left out in the cold due to actions beyond their control.

Sources: History Channel. "Here's What Caused the Great Recession." *YouTube*. May 15, 2018. https://www.youtube.com/watch?v=yM0uonkloXY. Accessed April 18, 2021; Randall D. Guynn, Davis Polk, and Wardwell LLP, "The Financial Panic of 2008 and Financial Regulatory Reform." *Harvard Law School Forum on Corporate Governance*. November 20, 2010. https://corpgov.law.harvard.edu/2010/11/20/the-financial-panic-of-2008-and-financial-regulatory-reform/. Accessed April 18, 2021; Sean Ross. "What Major Laws Were Created for the Financial Sector Following the 2008 Crisis?" *Investopedia*. Updated March 31, 2020. https://www.investopedia.com/ask/answers/063015/what-are-major-laws-acts-regulating-financial-institutions-were-created-response-2008-financial.asp. Accessed April 18, 2021.

## Why We Study Finance

Finance is the lubricant that keeps our economy running smoothly. Issuing a mortgage can be profitable for a bank, but it also allows people to live in their own homes and to pay for them over time. Do MasterCard, Venmo, and PayPal make money when you use their product? Sure, but think how much more convenient and safer it is to carry a card or use an app instead of cash. In addition, these services allow you to easily track where and how you spend your money. A well-regulated and independent financial system is important to capital-based economies. Our smoothly functioning financial system has removed us from the days of strictly bartering to our system today, where transactions are as simple as a tap on your mobile phone.

There are any number of professional and personal reasons to study finance. A search of the internet provides a long list of finance-related professions. Interviews with senior managers reveal that an understanding of financial tools and concepts is an important consideration in hiring new employees. Financial skills are among

2 Brookings Institution. "Ben S. Bernanke." *Brookings Institute*. https://www.brookings.edu/experts/ben-s-bernanke/; Ben S. Bernanke. "On Milton Friedman's 90th Birthday." *The Federal Reserve Board*. November 8, 2002. https://www.federalreserve.gov/boarddocs/speeches/2002/20021108/

the most important tools for advancement toward greater responsibility and remuneration. Government and work-guaranteed pension benefits are growing less common and less generous, meaning individuals must take greater responsibility for their personal financial well-being now and at retirement. Let's take a closer look at some of the reasons why we study finance.

There are many career opportunities in the fields of finance. A single course in finance such as this one may pique your interest and encourage you to study more finance-related topics. These studies in turn may qualify you for engaging and high-paying finance careers. We take a closer look at financial career opportunities in Careers in Finance.

A career in finance is just one reason to study finance. Finance is an excellent decision-making tool; it requires analytical thinking. Further, it provides a framework for estimating value through an assessment of the timing, magnitude, and risk of cash flows for long-term projects. Finance is important for more immediate activities as well, such as the development of budgets to assure timely distribution of cash flows such as dividends or paychecks.

An understanding of finance and financial markets opens a broader world of available financial investment opportunities. At one time, commercial bank deposits and the occasional investment in stocks, bonds, real estate, or gold may have provided sufficient coverage of investment opportunities, portfolio diversification, and adequate returns. However, in today's market of financial technology, derivative securities, and cryptocurrencies, an understanding of available financial products and categories is key for taking advantage of both new and old financial products.

LINK TO LEARNING

### Job Information

The internet provides a wealth of information about types of jobs in finance, as well as reasons to study it. Investigate the *Occupational Outlook Handbook (https://openstax.org/r/bls-gov)* issued by the Bureau of Labor Statistics to see how many of the career opportunities in finance look interesting to you. Think about the type of people you want to work with, the type of work-related activities you enjoy, and where you would like to live. Read "5 Reasons Why You Should Study Finance" at Harvard Business School Online (https://openstax.org/r/why-study-finance) to gain a better understanding of why finance offers a broad career path and is intellectually stimulating and satisfying.

## Risk and Return in Finance

Finance tells us that an increase in risk results in an increase in expected return. The study of historical financial markets demonstrates that this relationship generally holds true and that riskier investments over time have provided greater returns. Of course, this is not true all the time and under all conditions; otherwise, where's the risk?

At its most basic level, risk is uncertainty. The study of finance attempts to quantify risk in a way that helps individuals and organizations assess an appropriate trade-off for risk. Risk-return tradeoffs are all around us in our everyday decision-making. When we consider walking across the street in the middle of a city block or walking down to the marked intersection, we are assessing the trade-off between convenience and safety. Should you buy the required text for your class or instead rely on the professor's notes and the internet? Should you buy that new-to-you used car sight unseen, or should you spend the money for a mechanic to assess the vehicle before you buy? Should you accept your first job offer at graduation or hold out for the offer you really want? A better understanding of finance makes these types of decisions easier and can provide you, as the decision maker, with statistics instead of just intuition.

Return is compensation for making an investment and waiting for the benefit (see Figure 1.4). Return could be

the interest earned on an investment in a bond or the dividend from the purchase of stock. Return could be the higher income received and the greater job satisfaction realized from investing in a college education. Individuals tend to be risk averse. This means that for investors to take greater risks, they must have the expectation of greater returns. Investors would not be satisfied if the average return on stocks and bonds were the same as that for a risk-free savings account. Stocks and bonds have greater risk than a savings account, and that means investors expect a greater average return.

The study of finance provides us with the tools to make better and more consistent assessments of the risk-return trade-offs in all decision-making, but especially in financial decision-making. Finance has many different definitions and measurements for risk. Portfolios of investment securities tend to demonstrate the characteristics of a normal return distribution, or the familiar "bell-shaped" curve you studied in your statistics classes. Understanding a security's average and variability of returns can help us estimate the range and likelihood of higher- or lower-than-expected outcomes. This assessment in turn helps determine appropriate prices that satisfy investors' required return premiums based on quantifiable expectations about risk or uncertainty. In other words, finance attempts to measure with numbers what we already "know."

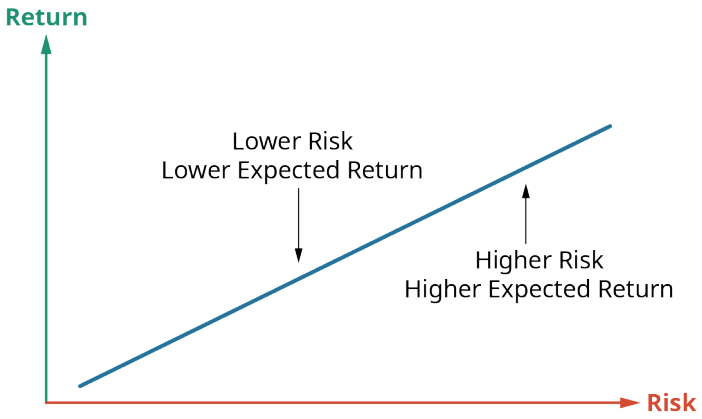


**Figure 1.4 Risk and Expected Return** This describes the trade-off that invested money can bring higher profits if the investor is willing to accept the risk of possible loss.

The overall uncertainty of returns has several components.

- **Default risk** on a financial security is the chance that the issuer will fail to make the required payment. For example, a homeowner may fail to make a monthly mortgage payment, or a corporation may default on required semiannual interest payments on a bond.
- **Inflation risk** occurs when investors have less purchasing power from the realized cash flows from an investment due to rising prices or inflation.
- **Diversifiable risk**, also known as unsystematic risk, occurs when investors hold individual securities or smallish portfolios and bear the risk that a larger, more well-rounded portfolio could eliminate. In these situations, investors carry additional risk or uncertainty without additional compensation.
- **Non-diversifiable risk**, or systematic risk, is what remains after portfolio diversification has eliminated unnecessary diversifiable risk. We measure non-diversifiable risk with a statistical term called *beta.* Subsequent chapters on risk and return provide a more in-depth discussion of beta.
- **Political risk** is associated with macroeconomic issues beyond the control of a company or its managers. This is the risk of local, state, or national governments "changing the rules" and disrupting firm cash flows. Political risk could come about due to zoning changes, product liability decisions, taxation, or even nationalization of a firm or industry.

# 1.2 The Role of Finance in an Organization

## Learning Outcomes

By the end of this section, you will be able to:

- Describe the finance function.
- Explain the role of finance and its importance within an organization.

## The Finance Function

Finance has many functions within an organization, and there are many job titles to reflect the varied job responsibilities. The **comptroller**, or more commonly a *controller*, in a for-profit business relies heavily on a knowledge of accounting. Controllers are in charge of financial reporting and the oversight of the accounting activities necessary to develop those reports. Controllers are concerned with payroll functions, accounts receivable, and accounts payable including taxes, inventory control, and any number of short-term asset and liability tracking and monitoring activities. They aid internal and external auditors and are responsible for monitoring and implementing the day-to-day financial operations of the firm.

In most organizations, the **treasurer** might assume many of the duties of the controller. However, the treasurer is also responsible for monitoring cash flow at a firm and frequently is the contact person for bankers, underwriters, and other outside sources of financing. A treasurer may be responsible for structuring loan and debt obligations and determining when and from whom to borrow funds. Treasurers are also responsible for investing excess funds. Where a controller may face inward toward the organization, the treasurer often faces outward as a representative to the public.

The vice president of finance (VP-F) is an executive-level position and oversees the activities of the controller and treasurer. The chief responsibility of the VP-F is to create and mentor a sufficient and qualified staff that generates reports that are timely, accurate, and thorough.

The **chief financial officer**, or **CFO**, is in a "big picture" position. The CFO sets policy for working capital management, determines optimal capital structure for the firm, and makes the final decision in matters of capital budgeting. The CFO is also forward looking and responsible for strategic financial planning and setting financial goals. Compared to a VP-F, a CFO is less of a "hands-on" manager and engages more in visionary and strategic planning.

## Financial Planning

Financial planning is critical to any organization, large or small, private or public, for profit or not-for-profit. Financial planning allows a firm to understand the past, present, and future funding needs and distributions required to satisfy all interested parties. For-profit businesses work to maximize the wealth of the owners. These could be shareholders in a publicly traded corporation, the owner-managers of a "mom and pop" store, partners in a law firm, or the principal owners of any other number of business entities. Financial planning helps managers understand the firm's current status, plan and create processes and contingencies to pursue objectives, and adjust to unexpected events. The more thoughtful and thorough the financial planning process, the more likely a firm will be able to achieve its goals and/or weather hard times. Financial plans typically consider the firm's strategic objectives, ethical practices, and sources and costs of funds, as well as the development of budgets, scenarios, and contingencies. The financial plan Bacon Signs developed was thorough enough to anticipate when and how growth might occur. The plan that was presented to commercial banks allowed the firm to be guaranteed new financing at critical moments in the firm's expansion.

Good financial planning has a number of common features.

- It uses past, current, and pro forma (forward-looking) income statements. Pro forma income statements are created using assumptions from past events to make projections for future events. These income statements should develop likely scenarios and provide a sensitivity analysis of key assumptions.

- Cash flow statements are a critical part of any financial planning. Cash flow statements estimate the timing and magnitude of actual cash flows available to meet financial obligations.
- Balance sheets are critical for demonstrating the sources and uses of funds for a firm. One of the most important aspects of business is accounting (see Figure 1.5).
- Forecasting in the form of expected sales, cost of funds, and microeconomic and macroeconomic conditions are essential elements of financial planning.
- Financial analysis including ratio analysis, common-size financial statements, and trend statements are important aspects of financial planning. Such analysis aids in the understanding of where a firm has been, how it stacks up against the competition, and the assessment of target objectives.

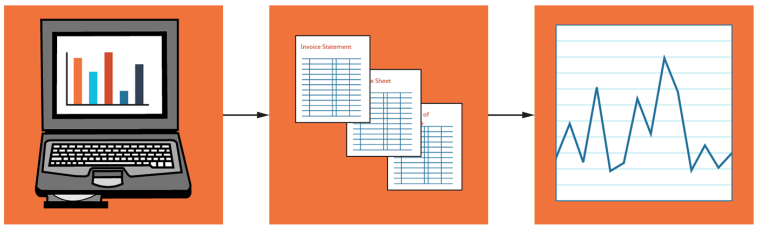


**Figure 1.5 The Accounting System** The accounting system relies on accurate data used to prepare all the financial reports that help to evaluate a firm.

LINK TO LEARNING

### Elements of a Financial Plan

You can view key elements in a financial plan (https://openstax.org/r/write-your-business-plan) at the US Small Business Administration's website.

## Forecasting and Budgeting

Forecasting and budgeting are common practices for businesses, governmental agencies, not-for-profit firms, and individual households. As with many of the financial topics introduced in this chapter, these activities are valuable for individuals and businesses alike. Budgeting, or planning for the amount, sources, and uses of cash, occurs early in the planning process. It is common for businesses to have developed an annual budget well before the start of the year. With budgeting, a firm establishes objectives for the upcoming period by developing financial statements based on historical data and expectations, as well as aspirations for the future. The budgeting process helps the firm identify what actions need to be undertaken to achieve its objectives. However, no matter how strong the budgeting process, actual events can change the timing and magnitude of expected cash flows.

Financial forecasting addresses the changes necessary to the budgeting process. Budgeting can help identify the differences or variance from expectations, and forecasting becomes the process for adapting to those changes. We attribute to President Eisenhower the saying that "plans are worthless, but planning is everything." That statement applies to business today as well as it did during his service in the military and government. The budgeting or planning process is a road map for organizations, and forecasting helps navigate the inevitable detours toward the firm's objectives.

The budgeting process develops pro forma financial statements such as income and cash flow statements and balance sheets. These provide benchmarks to determine if firms are on course to meet or exceed objectives and serve as a warning if firms are falling short. Budgeting should involve all departments within a firm to determine sources and uses of funds and required funding to meet department and firm objectives. The process should look to emulate successful processes and change or eliminate ineffective ones. Budgeting is a

periodic renewal and reminder of the firm's goals.

Financial forecasting often starts with the firm's budget and recommends changes based on differences between the budgeted financial statements and actual results. Forecasting adjusts management behavior in the immediate term and serves as a foundation for subsequent budgets.

# 1.3 Importance of Data and Technology

## Learning Outcomes

By the end of this section, you will be able to:

- Describe the role of data in finance.
- List and describe the various types of corporate data available.
- Explain how the various types of corporate data can be accessed and analyzed.
- Describe the impact of data digitization.
- Explain how stakeholders use data when making decisions.

## Importance of Data

Financial data is important for internal and external analysis of business firms. More accurate and timely data leads to better business and financial decision-making. Financial budgeting and forecasting rely on the creation of several types of financial statements including income statements, the statements of cash flow, and balance sheets, as well as the notes and assumptions used to create the financial statements. Insiders such as executive and middle managers use financial data to evaluate and reevaluate decision-making. Having current and accurate data is key to making consistent value-adding decisions for a firm. Data helps inform managers about how and when to finance projects, which projects to undertake, and necessary changes to make regarding physical, financial, and human resource assets. "Gut feelings" and "seat-of-the-pants" decision-making tend to be inconsistent with value maximization.

Outsiders also use publicly available data about firms to make purchasing, investment, credit, and regulatory decisions. Customers, investors, lenders, suppliers, and regulators must be able to access a firm's financial information. Investors need to determine how much they are willing to pay for a share of stock, banks need data to determine if a loan should be made, suppliers need financial information to determine if they should supply trade credit, and customers need to know that a firm has priced its products appropriately.

## Basic Data Types

Financial statements provide some of the data needed for decision-making. Firms summarize data and develop at least three essential financial statements or reports.

1. The income statement summarizes the flow of revenues and expenses over a specified period. Income statements for publicly traded companies are available quarterly.
2. Statements of cash flow identify actual receipt and use of cash over a period.
3. Balance sheets show the existing assets, liabilities, and equity as of a particular date.

These statements represent book values and reflect historical costs and accounting adjustments such as accumulated depreciation. Book values often differ significantly from market values. Market values look forward and reflect expectations, whereas book values represent what has occurred.

In addition to the internal data summarized on financial statements, firms and outside stakeholders also seek external sources of information. External data gathering includes surveys of customers and suppliers, market research, new product development, statistical analysis, agreements with creditors, and discussions with government officials. Broader macroeconomic data is also valuable as it applies to expected market demand, unemployment, inflation, interest rates, and economic growth.

## The Impact of Digitization

Data digitization makes the storage and transmission of data easier and more cost effective. Some data starts out as digital data, such as that from a Microsoft Suite product. The Excel files and Word documents we create are ubiquitous and easily stored and transmitted. Cloud storage and video conferencing are now the norm. Emails and Zoom meetings are quick, easy, and inexpensive ways to share and store information. Businesses now create an e-trail, or virtual paper trail, to document, verify, and share processes. Because data is now much easier to access, firms bear the added responsibility of ensuring that it is stored and secured properly so that individuals cannot inappropriately alter or delete information.

Data storage has changed significantly in the last decade as companies have moved the storage of digital data to the cloud. The advantages include only paying for the storage actually used, reduced energy consumption, access to specialized data protection services, and software and hardware maintenance. However, the risk of data hacks and the safety of data are key concerns in the storage of digitized information.

## Uses of Data

Taken together and separately, the internally generated financial statements can provide managers with a wealth of information to enable superior decision-making. Harvard Business School identifies six ways managers can use financial statements.[3]

1. Measuring the impact of business decisions such as new software, marketing plan, or product line
2. Aiding in the development of budgets by creating a starting point for future expectations
3. Aiding in cost cutting or the reduction of duplicate activities
4. Providing data-supported strategic planning and visioning
5. Ensuring consistent data and content across departments
6. Motivating teams to set, meet, and exceed goals and objectives

### CONCEPTS IN PRACTICE

#### How and Why Managers Use Financial Statements: The Case of Peloton

Should you lease a new car or buy one? Do you opt for the more expensive high-tech production equipment or reduce your upfront investment and pay higher labor costs over time? Is it better to finance a new product by borrowing money or selling new shares of stock? Should you manufacture overseas where the production costs are lower or in your own country where political and transportation costs are lower? Once you make your choice, how do you know if you've made the right decision? Understanding and applying financial principles can help.

For example, consider Peloton, the leader in social exercising with its bike, treadmill, and yoga platforms. In 2012, the principal founder, John Foley, was inspired to start the company because he lacked the time to attend bicycle exercise classes due to his demanding career and growing family. He enjoyed cycling classes, but they could be expensive and often did not fit into his schedule. He recognized that the most popular instructors had developed a bit of a cult following and that the music playlist was a critical component for many followers. His choice of the company name, Peloton, comes from the French word for a "pack of bike riders," familiar to anyone who has even loosely followed the annual Tour de France bike race. The company name evokes a measure of mystique and prestige.

Peloton started small and underwent five funding rounds in seven years before the company went public with an initial public offering in September 2019. Foley and his friends had the idea that they were a "purposeful music company" and needed to touch on all aspects of the workout experience including the

3 Catherine Cote. "How and Why Managers Use Financial Statements." *Business Insights.* June 16, 2020. https://online.hbs.edu/blog/post/how-managers-use-financial-statements

bike; video, audio, and music content; clothing design; competition among the riders; data gathering; and instructors for livestream and on-demand classes. They were selling an experience, not a bicycle. The equipment is expensive—a Peloton bike typically costs over $2,000. Peloton equips its studios with state-of-the-art camera and music systems and pays its instructors top dollar. Along the way, the founders made several critical financial decisions. They kept control of the firm by using private funding at the start.

How can we tell if Peloton has managed its resources well? The company started with $400,000 of funding to develop a prototype in 2012. By 2018, firm value increased to $4 billion with yet another round of private investor funding. As of April 2021, Peloton is a publicly traded company with a stock value of $34 billion. The executives are sacrificing profits in the short term to generate growth and long-term profitability. The firm uses its financial statements to identify sources and uses of funds, to test the effectiveness of advertising, and to forecast future profitability. Analysts like the firm, the stock price is up, and by many financial measures, Peloton has been a great success. Time will tell if the decisions made over the last several years will lead to long-term profitability or if the company has overinvested in marketing only to miss current and long-term profits.

(Sources: Viktor. "The Peloton Business Model—How Does Peloton Work & Make Money?" *Productmint*. Updated May 9, 2021. https://productmint.com/the-peloton-business-model-how-does-peloton-make-money/. Accessed May 18, 2021; John Ballard. "If You Invested $5,000 in Peloton's IPO, This Is How Much Money You'd Have Now." *The Motley Fool*. June 6, 2020. https://www.fool.com/investing/2020/06/06/if-you-invested-5000-in-pelotons-ipo-this-is-how-m.aspx. Accessed May 18, 2021; Erin Griffith. "Peloton's New Infusion Made It a $4 Billion Company in Six Years." *New York Times*. August 3, 2018. https://www.nytimes.com/2018/08/03/technology/pelotons-new-infusion-made-it-a-4-billion-company-in-6-years.html)

# 1.4 Careers in Finance

## Learning Outcomes

By the end of this section, you will be able to:

- Describe current job opportunities in finance.
- Describe the financial analyst role.
- Describe the business analyst role.

## Job Opportunities in Finance: Market Trends

There are many career opportunities in the field of finance. The Bureau of Labor Statistics (BLS) finds that as of May 2020, the median income for finance-related positions was $72,250 versus the overall median income of only $41,950. Further, the BLS predicts that close to an additional 500,000 new finance- and accounting-related jobs will be created by 2029.[4] These new employment opportunities are in addition to the many openings that will become available as baby boomers continue to retire and leave the workforce.

Several of the BLS-listed finance careers do not even have finance or associated wording in the career titles. The BLS identifies finance skills as necessary for careers such as management analysts and market research analysts and work in logistics. Of course, many careers traditionally encourage the study of finance. These include job titles and descriptions such as these:

- Financial manager: Oversees aspects of and produces reports about an organization's financial needs, uses, and related activities
- Investment relations associate: Prepares and presents company financial data to investors and other company stakeholders

4 U.S. Bureau of Labor Statistics. *Occupational Outlook Handbook*. https://www.bls.gov/ooh/business-and-financial/home.htm

- Budget analyst: Reviews, plans, and evaluates an organization's financial activities
- Credit analyst: Reviews financial and related information to determine the creditworthiness of potential clients and customers; typically works at commercial and investment banks, credit unions, and rating firms such as Moody's or Standard and Poor's
- Financial analyst: Collects and examines data to plan future activities and evaluate past decisions
- Personal financial advisor: Provides advice to clients for short-, intermediate-, and long-term financial planning
- Loan officer: Helps individuals and organizations apply for loans and typically works for depository financial institutions such as commercial banks
- Insurance underwriter: Evaluates risk and establishes prices for insurance products such as life, property, and casualty insurance
- Financial examiner: Evaluates and monitors the activities of depository institutions in an effort to assure proper practice and behavior
- Finance professor: Teaches college classes, engages in economic and financial research, and provides community service by serving on boards and providing financial expertise

LINK TO LEARNING

### Best Jobs in Finance

You can read more about possible careers in finance (https://openstax.org/r/thebalancecareers) at the Balance Careers website.

## Financial Analyst Roles

Many executive-level finance officers worked their way up via the role of financial analyst. Job descriptions vary across firms, industries, and government organizations. However, the role of financial analyst usually includes market research, financial forecasting, modeling, cost analysis, and comparative valuations. Financial analysts gather data and produce financial reports in conjunction with multiple departments within a business or organization. They rely on marketing and production personnel to provide accurate sales forecasts, and they work with accountants to create accurate financial reports.

As a financial analyst, you need strong spreadsheet skills, the ability to develop financial models and pro forma financial statements, outstanding analytical skills, and an overall understanding of business processes. Financial analysts possess a well-diversified collection of business and communication skills, both quantitative and qualitative. Figure 1.6 lists some tasks that financial analysts must perform on a daily basis. Some firms require an MBA or several years of business experience for their financial analysts.

**Figure 1.6 Financial Analyst Tasks**

Internal financial analysts are important for a successful firm or organization because their work can lead to more efficient and cost-effective use of financial and nonfinancial resources. Responsibilities include keeping current with market conditions, developing financial models, reconciling variance between forecasts and outcomes, and serving as a resource for management. Financial analysts fulfill their responsibilities through the development and analysis of financial data including ratio analysis, trend analysis, in-depth discussions with division managers, and the presentation and interpretation of information at meetings and on electronic platforms.

External financial analysts use similar resources and tools to evaluate financial instruments as an aid to investment companies, investment and commercial bankers, and individual investors who rely on their published reports. Various government agencies also use financial analysts to aid in regulatory oversight and enforcement.

A report from a 2019 BLS survey determines that financial analysts earn an average salary of $81,590, and jobs are predicted to grow at a faster-than-average rate of 5% through 2029.[5]

## Business (or Management) Analyst Roles

The job description for a business analyst looks much like that for a financial analyst. However, the strong quantitative skills required for a financial analyst are less emphasized in favor of overall strategic thinking. A successful business analyst is able to evaluate business opportunities by using analytical thinking, industry best practices, process development, team building and organization, and information technology. They then communicate optimal courses of action to executive decision makers to maximize value in alignment with the vision and goals of the firm.

Business analysts can help develop strategy and tactics to move a firm forward. They aid in identifying challenges and solutions. Data-driven solutions help get products to market more quickly, evaluate performance, and optimize production and product mix. The Bureau of Labor Statistics identifies the following as typical business analyst duties:

- Gathering information about problems to be solved or procedures to be improved
- Interviewing personnel and conducting onsite observations to determine the methods, equipment, and

5 Ibid.

personnel that will be needed
- Analyzing financial data, revenues and expenditures, and employment reports, among other data
- Finding root causes for problems and proposing solutions that may include new systems, procedures, or personnel changes
- Presenting findings to decision makers
- Conferring with managers to ensure changes work

The average salary for management analysts was $85,260 in May 2019, and the BLS projects 11% growth, or about 94,000 new jobs, over the next decade.[6]

# 1.5 Markets and Participants

## Learning Outcomes

By the end of this section, you will be able to:
- Identify primary and secondary markets.
- Identify key market players.

## Primary and Secondary Markets

Simply put, the **primary market** is the market for "new" securities, and the **secondary market** is the market for "used" securities. Think of the primary market as equivalent to the sale of new cars and the secondary market as equivalent to the sale of used cars. In practice, many market locales trade both new and used securities. For example, the stock markets trade equity securities daily, and most of the trading takes place among individual and institutional investors who own shares in publicly traded companies. Trading a share of Amazon, Facebook, or Nike stock has little impact and no direct cash flow to the underlying firm. However, the information provided by such transactions is valuable, as it is a costly and public real-time statement by investors of their perceptions of firm's value and a reflection of satisfaction and expectations.

Some, though many fewer, transactions in the equity market are for the purchase and sale of new securities. Firms issue new shares of stock called seasoned equity offerings (SEOs) or initial public offerings (IPOs) into the market. These are issues of new shares of stock, previously untraded, and their issuance sends cash flows directly to the underlying firms. SEOs are new shares issued by established firms, and IPOs are new shares issued by firms going public for the very first time. Once the initial transaction takes place, purchasers of these new securities may trade them. However, the second and subsequent trades are secondary, not primary, market transactions.

Extensive primary market transactions take place weekly, when the Treasury Department auctions billions of dollars of new Treasury securities. These new securities repay maturing Treasury securities and provide for the ongoing liquidity and long-term borrowing needs of the federal government. Again, subsequent trading of this government debt occurs as secondary market transactions.

## Key Market Players

Key market players in finance include dealers, brokers, financial intermediaries, and you and me. Each of these players facilitates the exchange of products, information, and capital in different ways. The presence of these players makes financial transactions, easier, faster, and safer—essentially more efficient. You and your friends might engage in direct financial transactions, such as buying a coffee or borrowing money for a movie. These are typically small transactions. However, for transactions that are larger or more complicated, you need advanced financial entities with capital, expertise, and networks. The two segments of the secondary markets are broker markets and dealer markets, as Figure 1.7 shows. The primary difference between broker and dealer markets is the way each executes securities trades.

6 Ibid.

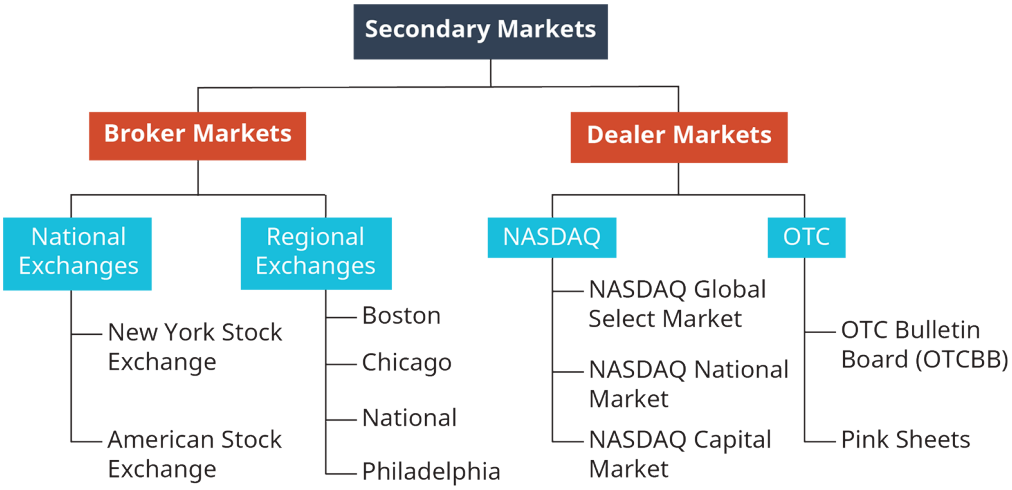


**Figure 1.7 Broker and Dealer Markets**

## Dealers

Financial **dealers** own the securities that they buy or sell. When a dealer engages in a financial transaction, they are trading from their own portfolio. Dealers do not participate in the market in the same manner as an individual or institutional investor, who is simply trying to make their investments worth as much as possible. Instead, dealers attempt to "make markets," meaning they are willing and able to buy and sell at the current bid and ask prices for a security. Rather than relying on the performance of the underlying securities to generate wealth, dealers make money from the volume of trading and the spread between their bid price (what they are willing to pay for a security) and their ask price (the price at which they are willing to sell a security). By standing ready to always buy or sell, dealers increase the liquidity and efficiency of the market. Dealers in the United States fall under the regulatory jurisdiction of the Securities and Exchange Commission (SEC). Such regulatory oversight ensures that dealers execute orders promptly, charge reasonable prices, and disclose any potential conflicts of interest with investors.

## Brokers

**Brokers** act as facilitators in a market, and they bring together buyers and sellers for a transaction. Brokers differ from dealers who buy and sell from their own portfolio of holdings. These firms and individuals traditionally receive a commission on sales.

In the world of stockbrokers, you may work with a discount broker or a full-service broker, and the fees and expenses are significantly different. A discount broker executes trades for clients. Brokers are required for clients because security exchanges require membership in the exchange to accept orders. Discount brokers or platforms such as Robinhood or E-Trade charge no or very low commissions on many of their trade executions, but they may receive fees from the exchanges. They also do not offer investment advice.

Full-service brokers offer more services and charge higher fees and commissions than discount brokers. Full-service brokers may offer investment advice, retirement planning, and portfolio management, as well as execute transactions. Morgan Stanley and Bank of America Merrill Lynch are examples of full-service brokers that serve both institutional and individual investors.

## Financial Intermediaries

A **financial intermediary**, such as a commercial bank or a mutual fund investment company, serves as an intermediary to enable easier and more efficient exchanges among transacting parties. For instance, a commercial bank accepts deposits from savers and investors and creates loans for borrowers. An investment company pools funds from investors to inexpensively purchase and manage portfolios of stocks and bonds. These transactions differ from those of a dealer or broker. Brokers facilitate trades, and dealers stand ready to buy or sell from their own portfolios. Financial intermediaries, however, accept money from investors and may

create a completely different security all together. For example, if the borrower defaults on a mortgage loan created by the commercial bank where you have your certificate of deposit, your investment is still safely earning interest, and you are not directly affected.

Financial institutions usually facilitate financial intermediation. However, occasionally lenders and borrowers are able to initiate transactions without the help of a financial intermediary. When this occurs on a large scale, the process, known as disintermediation, can cause much turmoil in the financial markets. In the 1970s, inflation rose above 10% on an annual basis, and yet commercial banks were limited to offering maximum rates of 5% on their savings deposits.[7] Savers bypassed banks and savings and loan associations to invest directly into Treasury securities and other short-term marketable securities. This lack of deposit funds and the subsequent behavior of the industry essentially eliminated the savings and loan industry and led to significant deregulation of commercial and investment banking in the United States.

The advantages of a robust network of financial intermediaries are many. They add efficiency to the financial system through lower transaction costs. They gather and disperse information to minimize financial abuse and fraud. They provide economies of scale and specialized knowledge. Finally, financial intermediaries are critical for the functioning of a capitalist economy.

# 1.6 Microeconomic and Macroeconomic Matters

## Learning Outcomes

By the end of this section, you will be able to:

- Define microeconomics and macroeconomics.
- Discuss the relationship between microeconomics and macroeconomics.
- Explain the importance of macroeconomic variables in finance markets.

## Microeconomics

In the business setting, finance is the intersection of economics and accounting. Financial decision makers rely on economic theory and empirical evidence combined with accounting data to make informed decisions for their organization. Economics is the study of the allocation of scarce resources. Economists attempt to understand the how and why of human and financial capital allocation to governments, businesses, and consumers.

We typically separate economics into two major areas, microeconomics and macroeconomics. Microeconomics is devoted to the study of these decisions of allocation by individual businesses, persons, or organizations. Microeconomics helps us understand incentives and behavior, consumer choices and consumption, and supply and demand.

Our understanding of microeconomics aids in financial forecasting, planning, and budgeting by understanding how individuals are likely to respond to changes in product or service functionality, price, supply, quality, marketing, or other firm-induced stimulus. Empirical research by individuals, businesses, academics, and government provide evidence of what is going on and suggest what may change or stay the same.

## Macroeconomics

Whereas microeconomics studies the decisions of individuals, macroeconomics examines the decisions of groups. Macroeconomic areas of study and concern include inflation, income, economic growth, and unemployment. When Bacon Signs developed a financial and operating plan to expand the business, the firm had to consider unemployment and inflation when estimating its price of labor and materials. Bacon Signs also had to consider interest rates when estimating the cost of borrowing money to expand the business.

Macroeconomic modeling is limited because models cannot capture every variable in testing and application.

7 United States President and Council of Economic Advisers. "The 1970s: Inflation, High Interest Rates, and New Competition." *Economic Report of the President*. 1991. https://fraser.stlouisfed.org/files/docs/publications/ERP/pages/6688_1990-1994.pdf

However, financial forecasting must incorporate macroeconomic assumptions and expectations into individual firm and industry forecasts. Economic Foundations expands on our discussion of micro- and macroeconomics.

## Importance of Macroeconomic Variables in Financial Markets

To make financial forecasts, managers need good information to understand the relationship among several economic variables. Working from small to large, sales forecasts estimate the likely price and quantity of goods sold. In doing so, the forecaster will consider local, regional, state, national, and international economic conditions. Inflation is an important macroeconomic variable that influences prices. Every quarter, financial information hubs, such as the Wall Street Journal (WSJ), and government agencies and regulatory bodies, such as the Treasury Department and the Federal Reserve, release estimates about expected and current inflation. This information informs policy makers how to adjust the money supply to meet target objectives. Financial forecasters pay close attention to current and expected interest rates, as they have a fundamental impact on the cost of raising money and determining the required rate of return for investment.

The unemployment rate helps inform financial forecasters about the expected cost of labor and the ability of employers to hire people if a firm plans to increase the production of goods or services. The stock market is a forward-looking macroeconomic variable and measures investor expectations about future cash flows and economic growth. Political economic variables such as changes in regulation or tax policy can also affect forecasting models.

### LINK TO LEARNING

#### Politics and Stock Markets

Politics and stock market returns make for heated conversations. Who can run the country's economic system better, Republicans or Democrats? Presidents often take the credit or blame for overall economic performance even though their actual influence is less than you might think. See this fun comparison chart (https://openstax.org/r/macrotrends-net) of political economic performance that measures stock market returns by each administration going back to President Warren Harding in 1920. Who had the highest overall increase in the market? What president in the 21st century oversaw an overall decline in the market? Just to get things going, who had better overall market returns after four years in office, Donald Trump or Barack Obama?

Each of the variables we have identified—inflation, interest rates, unemployment, economic growth, the stock market, and government fiscal policy—are macroeconomic factors. They are beyond the scope and influence of individual firms, but combined, they play a critical role in establishing the market in which firms compete. A better understanding of the interaction of these macro variables with each other and with individual micro or firm-specific variables can only strengthen financial forecasting and management decision-making.

### CONCEPTS IN PRACTICE

#### Here, There, and Everywhere: Where Did Your iPhone Come From?

How do international macroeconomic factors affect investment decisions for businesses and individuals? Foreign investment adds risk and potential return to the decision-making process. Macroeconomic factors such as different inflation rates, unexpected changes in currency exchange rates, and mismatched economic growth all add to the uncertainty of making investments abroad. Just as important are government regulations limiting pollution, exploitation of precious minerals, labor laws, and tariffs. Toss in a pandemic, and a bottleneck or two, and suddenly international macroeconomic factors can affect almost every aspect of commerce and international trade.

For example, how far did your new iPhone travel before it got into your hands? Apple is an American company headquartered in Cupertino, California, and worth over $2 trillion.[8] However, your phone may have visited as many as six continents before it reached you. Each location touched by the Apple corporate hand requires an understanding of the financial impact on the product cost and a comparison with alternative designs, resources, suppliers, manufacturers, and shippers. This is where finance can get really fun!

(Sources: Magdalena Petrova. "We Traced What It Takes to Make an iPhone, from Its Initial Design to the Components and Raw Materials Needed to Make It a Reality." *CNBC*. December 14, 2018. https://www.cnbc.com/2018/12/13/inside-apple-iphone-where-parts-and-materials-come-from.html; Natasha Lomas. "Apple's Increasingly Tricky International Trade-offs." *TechCrunch*. January 6, 2019. https://techcrunch.com/2019/01/06/apples-increasingly-tricky-international-trade-offs/; Kif Leswing. "Here's Why Apple Is So Vulnerable to a Trade War with China." *CNBC*. May 13, 2019. https://www.cnbc.com/2019/05/13/why-is-apple-so-vulnerable-to-a-trade-war-with-china.html)

## Relationship between Microeconomics and Macroeconomics

In the parable, a group of blind people happen upon an elephant for the first time, and they each touch one part—but one part only—of the elephant. Subsequently, when they each describe what they have discovered, the descriptions are vastly different. The group's members become upset, accusing one another of inaccurate descriptions or worse. The parable demonstrates how individuals can make absolute truths from their own limited and subjective information. Financial decision makers run a similar risk, if they choose to recognize only their own findings and ignore other microeconomic or macroeconomic information and the interaction of these factors.

A common view to understanding economics states that macroeconomics is a top-down approach and microeconomics is a bottom-up approach. Financial decision makers need to see both the forest and the individual trees to chart a course and move toward a strategic objective. They need both the macro data, so important for strategic thinking, and the micro data, required for tactical movement. For example, the national rate of unemployment may not have been much help when Bacon Signs was searching for skilled laborers who could form neon signs. However, the unemployment rate helped inform the company about the probability of demand for new businesses and the signs they would need.

# 1.7 Financial Instruments

### Learning Outcomes

By the end of this section, you will be able to:

- Differentiate between money and capital markets.
- List money market instruments.
- List capital market instruments.

## Money Markets and Instruments

The **money market** is the market for short-term, low-risk, highly liquid securities. "Short-term" refers to **money market securities** having maturities of less than one year–sometimes as short as overnight. "Low risk" specifically means that the probability of default by the issuer is very unlikely. Defaulting on money market instruments is not unheard of, but it is very rare. "High liquidity" means that money market instruments can generally be sold in a secondary market very quickly and at or near their current market value. Finally, money market securities are homogeneous, meaning that within an issue of securities, a single instrument is not

8 Sergei Klebnikov. "Apple Becomes First U.S. Company Worth More Than $2 Trillion." *Forbes*. August 19, 2020. https://www.forbes.com/sites/sergeiklebnikov/2020/08/19/apple-becomes-first-us-company-worth-more-than-2-trillion/

unique. For example, if you purchase 13-week T-bills issued in the first week of January, each bill is identical to any other in the issue. Compare that to the purchase of physical assets such as a car or house, where each of the assets sold has some unique feature or measure of quality.

Financial institutions, corporations, and governments that have short-term borrowing and/or lending needs issue securities in the money market. Most of the transactions are quite large, with typical amounts in excess of $100,000. These large transactions are the norm when trading federal funds, repurchase agreements, commercial paper, or negotiable certificates of deposit. Our sample company, Bacon Signs, was much too small to participate directly in the money market. However, Bacon Signs' borrowing rates were affected by changes in the money market. Treasury bills are also a very important component of the money market, and they trade in smaller amounts starting at $10,000 per T-bill.

**Treasury bills (T-bills)**, are short-term debt instruments issued by the federal government. T-bills are auctioned weekly by the Treasury Department through the trading window of the Federal Reserve Bank of New York. The federal government uses T-bills to meet short-term liquidity needs. T-bills have very short maturities and a broad secondary market and are default-risk free. T-bills are also exempt from state and local income taxes. As a result, they carry some of the lowest effective interest rates on publicly traded debt securities. In addition to the regular auction of new T-bills, there is also an active secondary market where investors can trade used or previously issued T-bills. Since 2001, the average daily trading volume for T-bills has exceeded $75 billion.[9]

**Commercial paper (CP)** is a short-term, unsecured debt security issued by corporations and financial institutions to meet short-term financing needs such as for inventory and receivables. For example, credit card companies use commercial paper to finance credit card payments. Commercial paper has a maturity of one to 270 days. The short maturity reduces SEC oversight. The lesser oversight and the unsecured nature of CP means that only highly rated firms are able to issue the uninsured paper. The default rate on commercial paper is typically low, but default rates did increase into the double-digit range during the financial crisis of 2008.

Commercial paper typically carries a minimum face value of $100,000 and sells at a discount with the face value as the repayment amount. Corporations and financial institutions, not the government, issue commercial paper; thus, returns are taxable. Further, unlike T-bills, there is not a robust secondary market for CP. Most purchasers are large, such as mutual fund investment companies, and they tend to hold commercial paper until maturity.

**Negotiable certificates of deposit (NCDs)** are very large CDs issued by financial institutions. They are redeemable only at maturity, but they can and often do trade prior to maturity in a broad secondary market. NCDs, or *jumbo CDs*, are so called because they sell in increments of $100,000 or more. However, typical minimums amounts are $1,000,000 with a maturity of two weeks to six months.

NCDs differ in some important ways from the typical CD you may be familiar with from your local bank or credit union. The typical CD has a maturity date, interest rate, and face amount and is protected by deposit insurance. However, if an investor wishes to cash out prior to maturity, they will incur a substantial penalty from the issuer (bank or credit union). An NCD also has a maturity date and amount but is much larger than a regular CD and appeals to institutional investors. The principal is not insured. When the investor wishes to cash out early, there is a robust secondary market for trading the NCD. The issuing institution can offer higher rates on NCDs compared to CDs because they know they will have use of the purchase amount for the entire maturity of the NCD. The reserve requirements on NCDs by the Federal Reserve are also lower than for other types of deposits.

The market for **federal funds** is notable because the Federal Reserve targets the equilibrium interest rate on

9 Henrik Bessembinder, Chester Spatt, and Kumar Venkataraman. "A Survey of the Microstructure of Fixed-Income Markets." *Journal of Financial and Quantitative Analysis*. February 2020. https://www.sec.gov/spotlight/fixed-income-advisory-committee/survey-of-microstructure-of-fixed-income-market.pdf

federal funds as one of its most important monetary policy tools. The federal funds market traditionally consists of the overnight borrowing and lending of immediately available funds among depository financial institutions, notably domestic commercial banks. The participants in the market negotiate the federal funds interest rate. However, the Federal Reserve effectively sets the target interest rate range in the federal funds market by controlling the supply of funds available for use in the market. Many of the borrowing and lending rates in our economy are a direct function of the federal funds rate.

## Capital Markets and Instruments

The **capital market** is the market for longer-term financial instruments. The capital market is similar to the money market. However, maturities are longer, default risk varies to a greater degree from low to high, and liquidity is less certain, as is the homogeneity of the financial instruments. Broadly, we separate capital market instruments into debt instruments traded in the bond markets and equity securities traded on the stock markets.

The federal government issues Treasury notes and bonds to raise money for current spending and to repay past borrowing. The size of the Treasury market is quite large, as the US federal government over the years has accumulated a total indebtedness of over $28 trillion.[10]

**Treasury notes** are US government debt instruments with maturities of 2 to 10 years. The Treasury auctions notes on a regular basis, and investors may purchase new notes from TreasuryDirect.gov in the same way they would a T-bill. T-notes differ from T-bills in that they are longer term, pay semiannual coupon interest payments, and pay the par or face value of the note at maturity. Upon issue of a note, the size, number, and timing of note payments is fixed. However, prices do change in the secondary market as interest rates change. Like T-bills, T-notes are generally exempt from state and local taxes. There is an active secondary market for Treasury notes.

Longer-term Treasury issues, **Treasury bonds**, have maturities of 20 or 30 years. T-bonds are like T-notes in that they pay semiannual coupon interest payments for the life of the security and pay the face value at maturity. They are longer term than notes and typically have higher coupon rates.

State and local governments and taxing districts can issue debt in the form of **municipal bonds ("munis")**. Local borrowing carries more risk than Treasury securities, and default or bankruptcy is unlikely but possible. Thus, munis have ratings that run a spectrum similar to that of corporate bonds in that they receive a bond rating based on the perceived default risk. The defining feature of municipal bonds is that some interest payments are tax-free. Interest on munis is always exempt from federal taxes and sometimes exempt from state and local taxes. This makes them very attractive to investors in high income brackets.

Just as governments borrow money in the long-term from investors, so do corporations. A corporation often issues bonds for longer-term financing. Bond contracts identify very specific terms of agreement and outline the rules for the order, timing, and amount of contractual payments, as well as processes for when one or more of the required activities lapse. A bond contract, known as an indenture, includes both standard "boilerplate" contract language and specific conditions unique to a particular issue. Because of these non-standardized features of a bond contract, the secondary market for trading used bonds typically requires a broker, dealer, or investment company to facilitate a trade.

An important goal of business executives is to maximize the owners' wealth. For corporations, shares of stock represent ownership. Stocks are difficult to price compared to bonds. Bonds have contracts that specify the number and amount of all payments made by the firm to the purchasers of bonds. Stock cash flows are far more uncertain than bond cash flows. Stocks might or might not have periodic dividend payments, and an investor can plan to sell the stock at some point in the future. However, no contract guarantees the size of the dividends or the time or resale price of the stock. Thus, the cash flows from stock ownership are more

10 Trading Economics. "United States Government Debt." *Trading Economics*. https://tradingeconomics.com/united-states/government-debt

uncertain and risky than cash flows from bonds.

Ownership of corporations is easily transferable if a company's stock trades in one of the organized stock exchanges or in the over-the-counter (OTC) market. Most of the trading consists of used or previously issued stocks in the over-the-counter market and organized exchanges. The two largest stock exchanges in the world are the New York Stock Exchange (NYSE) and the NASDAQ. Both exchanges are located in the United States.

# 1.8 Concepts of Time and Value

## Learning Outcomes

By the end of this section, you will be able to:

- Explain the impact of time on saving and spending.
- Describe economic value.

Many students don't have a choice between saving and spending. College is expensive, and it is easy to spend every dollar you earn and to borrow to meet the rest of your obligations. Businesses, however, continually make decisions about when and how much money to borrow or invest. Bacon Signs established banking relationships to borrow money when needed to expand the business or a product line. Sometimes the best decision is to invest as soon as possible to grab opportunities, and other times it is better to delay new investment in order to pay dividends to the owners of the company.

### LINK TO LEARNING

#### The Dow Jones Industrial Average Marches On!

Once you begin to save and invest, here is a "fun fact" about the Dow Jones Industrial Average (DJIA) (https://openstax.org/r/investopedia-djia), also known as the Dow 30. It first appeared on May 26, 1896, as a quick way for stock traders to assess if the stock market had gone "up or down" each day and by how much. Here we are over 100 years later, and the Dow 30 index is alive and well. Of course, the 30 companies have changed, but the index does represent a continuous yardstick to measure stock performance over time. As Table 1.1 shows, it took from 1906 to 1972, or a little over 66 years, for the Dow 30 to increase tenfold, from a value of 100 to a value of 1,000. The next tenfold increase from 1,000 to 10,000 took only a little under 27 years from 1972 to 1999. Time will tell if or when the Dow 30 will top 100,000 at the closing bell.

| Closing Milestones | Date |
|---|---|
| 41 | 5/26/1896 |
| 100 | 1/12/1906 |
| 1,000 | 11/14/1972 |
| 10,000 | 3/29/1999 |
| 20,000 | 1/25/2017 |
| 30,000 | 11/24/2020 |

**Table 1.1 The Dow 30 Closing Milestones and Dates**

## Impact of Time on Saving and Spending

The choice to spend or save and invest is really a choice between consumption today versus consumption in the future. Economists, investment advisers, your friends, and mine love to discuss the trade-off of consumption now or later—even if not in those words. We have all heard conversations that go something like

this: “Let’s go grab a beer—you can study for tomorrow’s exam in the morning.” Or “My father’s investment adviser told me that if I invest $500 per month for the next 30 years and earn an annual rate of 10% on my investments, I will have invested $180,000 over time but accumulated an investment portfolio worth over $1.13 million!”

An important aspect of the trade-off between saving and spending involves your short-, intermediate-, and long-term goals. Delaying consumption until later comes with risks. Will your consumption choices still be available? Will the prices be attainable? Will you still be able to consume and enjoy your future purchases?

When saving for short-term objectives, the safety of the principal invested is important, and the value of compounding returns is minimal compared to longer-term investments. Most short-term investors have a low tolerance for risk and hope to beat the rate of inflation with a little extra besides. An example could be to start a holiday savings account at your local bank as a way to save, earn a small rate of return, and assure that you have funds set aside for consumption at the end of the year.

An intermediate investment may be to save for a new car or for the down payment on a house or vacation home. Again, maintaining the principal is important, but you have some time to recover from poor investment returns. Intermediate-term investments tend to earn higher average annual rates of return than short-term investments, but they also have greater uncertainty and risk.

Long-term investments have the advantage of enough time to recover from temporary poor performance and the luxury of compounded returns over a long period. Further, long-term investments tend to have greater risk and higher expected average annual rates of return. Even though this is a business finance text, sometimes a personal finance example is easier to relate to. To illustrate, Table 1.2 demonstrates four different investment scenarios. In scenario 1, you invest $5,000 annually from ages 26 through 60 into an account earning an average annual rate of return of 10% per year. Over your lifetime, you invest a total of $175,000, and at age 60, you have an estimated portfolio value of $1,490,634. This is a healthy amount that has almost certainly beaten the average annual rate of inflation. In scenario 1, by investing regularly, you accumulate roughly 8.5 times the value of what you invested. Congratulations, you can expect to become a millionaire!

Compare your results in scenario 1 with your college roommate in scenario 2, who is able to invest $5,000 per year from ages 19 through 25 and leave her investments until age 60 in an account that continues to earn an annual rate of 10%. She makes her investments earlier than yours, but they total only $35,000. However, despite a much smaller investment, her head start advantage and the high average annual compounded rate of return leave her with an expected portfolio value of $1,466,369. Her total is almost as great as the amount you would accumulate, but with a much smaller total investment.

Scenarios 3 and 4 are even more dramatic, as can be seen from a review of Table 1.2. In both scenarios, only five $5,000 investments are made, but they are made earlier in the investor’s life. Parents or grandparents could make these investments on behalf of the recipients. In both scenarios, the portfolios grow to amounts greater than those of you or your roommate with smaller total investments. The common factor is that greater time leads to additional compounding of the investments and thus greater future values.

| | Average Annual Rate of Return = 10% | | | |
|---|---|---|---|---|
| **Assumptions** | **Scenario 1** | **Scenario 2** | **Scenario 3** | **Scenario 4** |
| Starting investment age | 26 | 19 | 14 | 9 |
| Ending investment age | 60 | 25 | 18 | 13 |
| Total investments | 35 | 7 | 5 | 5 |
| Annual investment | $5,000 | $5,000 | $5,000 | $5,000 |

**Table 1.2 Four Investment Scenarios: Assumptions and Expected Outcomes**

| | Average Annual Rate of Return = 10% | | | |
|---|---|---|---|---|
| **Assumptions** | **Scenario 1** | **Scenario 2** | **Scenario 3** | **Scenario 4** |
| Total investment amount | $175,000 | $35,000 | $25,000 | $25,000 |
| Value at age 60 | $1,490,634 | $1,466,369 | $1,838,858 | $2,961,500 |

**Table 1.2 Four Investment Scenarios: Assumptions and Expected Outcomes**

## Definition of Economic Value

*Value* is a term used frequently in business and especially in economics, accounting, and finance. Accountants track, record, and display value in the form of financial statements and footnotes. The numbers they present are "book values" and represent what has occurred. Financial people like to speak in terms of "market values." Market values are calculated using expected future cash flows discounted to today. Market values are the prices that consumers pay for a product. **Economic value** is what we believe consumers are actually willing to pay for a product, service, or experience. For example, the price of a movie ticket may be $10, but there are individuals who are willing to pay far more for the experience of watching a movie on the big screen.

Generally, the economic value is at least as great as the market value or current price of an asset. When Bacon Signs planned for the future, the firm attempted to determine the economic value of its products when creating an optimal mix of price and quantity sold. Firms that produce unique products for clients may have multiple prices based on the estimated economic value of their good or service to the client. One way to think about the difference between market value and economic value is that market value is what you have to pay, while economic value is what you are willing to pay.

# Summary

## 1.1 What Is Finance?

Finance is the study of the trade-off between risk and expected return. There are three broad areas of finance: business finance, investments, and financial markets and institutions.

## 1.2 The Role of Finance in an Organization

The accounting department creates financial statements, and the finance department implements the firm's policy objectives, monitors results, and responds to necessary strategic and tactical changes. Finance is responsible for budgeting and forecasting. Finance aids in establishing firm objectives and is responsible for meeting with creditors, lenders, owners, regulators, and other stakeholders that provide capital to the firm or have a claim against firm assets.

## 1.3 Importance of Data and Technology

Much of the data used in business today has been available for many years. However, data today is more attainable than ever due to technological advancements facilitating a user's ability to gather, evaluate, and store information faster and more cost effectively than ever. Information is continually available, so the quicker and less expensively firms can adjust to the arrival of new information, the more valuable they become for their stakeholders.

## 1.4 Careers in Finance

Careers in finance are plentiful, fulfilling, and well compensated. Introductory positions are available in areas such as data collection and data entry. More skill and experience is required for roles such as data analysis and forecasting. Eventually, executive-level positions such as CFO present themselves to the most qualified. Finance careers are not limited to financial firms, as understanding finance is an important skill in government regulatory positions, nonprofit management, and all types of commercial business—from real estate, to retail, to manufacturing, to education.

## 1.5 Markets and Participants

Financial markets are where buyers and sellers of financial securities come together to trade. The trading of securities allows markets to value assets and signal value as new information arrives. Brokers operate to bring buyers and sellers together and receive commissions. Dealers trade from their own portfolios and are often willing to make markets for specific securities by agreeing to buy or sell at the current bid and ask prices. Financial intermediaries actually change or create new financial products.

## 1.6 Microeconomic and Macroeconomic Matters

Economics is the study of the allocation of scarce resources. Economists attempt to understand the how and why of human, physical, and financial capital allocation. Microeconomics is the study of factors affecting an individual's consumption, and macroeconomics is the study of all the aggregate factors affecting an economy. Economics is important in finance due to the number of economic variables critical to good financial forecasting.

## 1.7 Financial Instruments

Maturity is one method to differentiate among financial instruments. Using this methodology, we have money markets and capital markets. Money markets consist of short-term marketable securities, and capital markets focus on longer-term securities such as bonds and stocks.

## 1.8 Concepts of Time and Value

The concepts of time and value involve the resolution of conflict between consumption now versus consumption later. Time and value represent the trade-off between risk and expected return. Many financial

exercises examine the relationships among time, interest rates, risk, cash flows now, and cash flows in the future. You can expect to solve several "time value of money" problems before you complete this book.

## Key Terms

**brokers** individuals or a firm that brings together potential buyers and sellers of a product and receives a commission at transaction

**business finance** the study and application of how managers can apply financial principles to maximize the value of a firm in a risky environment

**capital budgeting** the process of determining which long-term or fixed assets to acquire in an effort to maximize shareholder value

**capital market** market for longer-term financial instruments, such as stocks and bonds, used to finance long-term projects for organizations

**capital structure** the mix of financing, usually debt and equity, used by a firm

**chief financial officer (CFO)** an executive-level officer who sets policy for working capital management, determines optimal capital structure for the firm, and makes the final decision in matters of capital budgeting

**commercial paper (CP)** short-term, unsecured financial obligations issued by firms as a means of short-term financing for items such as inventory or payables

**comptroller** also referred to as *controller,* individual in charge of financial reporting and the oversight of the accounting activities necessary to develop financial reports

**dealers** facilitate a market and the trading of securities by holding a portfolio of the underlying asset for easy purchase and sale; earn money on the spread between ask and bid prices for the asset

**default risk** the risk that the issuer of a financial security will be unable to make payments as specified in the terms of a financial contract

**diversifiable risk** also called *unsystematic risk*, a risk that can be eliminated without the loss of expected return by holding a portfolio of securities

**economic value** the amount a consumer is willing to pay for a particular asset or service, usually greater than or equal to the current market price or present value of the asset

**federal funds rate** the rate targeted by the Federal Reserve in the implementation of monetary policy

**financial industry regulatory authority (FINRA)** an independent, nongovernmental organization that writes and enforces the rules governing registered brokers and broker-dealer firms in the United States

**financial intermediary** a commercial bank or a mutual fund investment company that serves as an intermediary to enable easier and more efficient exchanges among transacting parties, often accepting one form of financial asset from which they create another, such as taking demand deposits to create mortgage loans

**financial markets and institutions** one of the three main areas of the field of finance; firms and regulatory agencies that oversee our financial system

**inflation risk** the risk of reduced purchasing power of goods and services due to rising prices

**investments** one of the three main areas of finance; products and processes used to create individual and institutional portfolios with the intent of growing wealth

**money market** the market for short-term, low-risk, highly liquid, homogeneous financial securities; common money market securities include T-bills, NCDs, and commercial paper

**money market mutual funds** created by investment companies to pool the money of many investors to purchase and then manage short-term, low-risk, liquid financial portfolios of securities

**municipal bonds (munis)** long-term debt obligations issued by state or local governments that often have important tax advantages relative to corporate bonds

**negotiable certificate of deposit** very large CDs issued by financial institutions, redeemable only at maturity but can and often do trade prior to maturity in a broad secondary market; also called *jumbo CDs* because they sell in increments of $100,000 or more

**non-diversifiable risk** risk that cannot be eliminated by simply holding a portfolio of securities; also known as systematic risk

**political risk** the risk of local, state, or national governments "changing the rules" and disrupting firm cash flows

**primary market** a term used in financial markets to identify the market for the purchase and sale of new securities

**secondary market** a term used in financial markets to represent the purchase or sale of used securities that trade after the initial sale by the offering firm

**Securities Investor Protection Corporation (SIPC)** a nonprofit corporation that provides brokerage customers up to $500,000 coverage for cash and securities held by the firm

**treasurer** position responsible for monitoring cash flow at a firm and frequently is the contact person for bankers, underwriters, and other outside sources of financing

**Treasury bills (T-bills)** short-term debt obligations of one year or less issued by the US government

**Treasury bonds** long-term debt obligations issued by the US government characterized by having maturities of greater than 10 years and making periodic interest payments as well as principal payment at maturity

**Treasury notes** long-term debt obligations issued by the US government characterized by having maturities of 2 to 10 years and making periodic interest payment as well as principal payment at maturity

**working capital management** the development, oversight, and management of a firm's short-term assets and liabilities

## Multiple Choice

1. Which of the following was NOT identified by your authors as one of the three main areas of financial study?
   **a.** business finance
   **b.** capital budgeting
   **c.** investments
   **d.** financial markets and institutions

2. What is the process of determining which long-term or fixed assets to acquire in an effort to maximize shareholder value?
   **a.** Business finance
   **b.** Capital budgeting
   **c.** Investments
   **d.** Financial markets and institutions

3. In an organization with each of these financial positions, which title is most likely to be associated with a job description that is less of a "hands-on" manager and that engages more in visionary and strategic planning?
   **a.** comptroller (or controller)
   **b.** treasurer
   **c.** vice president of finance
   **d.** chief financial officer (CFO)

4. Which of the following statements is false?
   **a.** Financial planning is an important tool of for-profit organizations such as corporations and partnerships but is not important for not-for-profit enterprises such charitable organizations or governments.
   **b.** Good financial planning considers past, present, and pro forma income statements.
   **c.** Balance sheets are critical elements of the financial planning process and help demonstrate expected sources and uses of funds.
   **d.** Forecasting in the form of expected sales, cost of funds, and micro- and macroeconomic conditions are

essential elements of financial planning.

5. Which of the following statements regarding data is generally NOT true?
   **a.** Financial data is important for internal and external analysis of business firms.
   **b.** Outsiders use publicly available data about firms to make investment and regulatory decisions.
   **c.** "Gut feelings" decision-making tends to be more consistent with value maximization.
   **d.** Suppliers need financial information to determine if they should supply trade credit, and customers need to know if a firm's products are reliable and appropriately priced.

6. Which of the following is generally NOT true about cloud data storage versus on-site data storage?
   **a.** Cloud data storage provides storage cost advantages.
   **b.** Cloud data storage causes increased energy consumption.
   **c.** Cloud data storage comes with specialized data protection services.
   **d.** Cloud data storage comes with specialized maintenance services.

7. Which of the following describes United States Bureau of Labor Statistics (BLS) expectations of jobs using financial skills in the next decade?
   **a.** plentiful but low paying
   **b.** few and low paying
   **c.** plentiful and high paying
   **d.** few and high paying

8. Which of the following organizations would be unlikely to hire a financial analyst?
   **a.** Government agencies may hire financial analysts to aid in regulatory oversight and enforcement.
   **b.** Investment companies may hire financial analysts to produce financial reports.
   **c.** Corporations may hire financial analysts to develop financial forecasts.
   **d.** All of the above organizations are likely to hire and develop financial analysts.

9. The _____ market is the market for _____ securities, and the _____ is the market for _____ securities.
   **a.** primary; used; secondary; new
   **b.** primary; new; secondary; used
   **c.** secondary; new; primary; new
   **d.** secondary; used; primary; used

10. _____ own the securities that they buy or sell; when they engage in a financial transaction, they are trading from their own portfolio.
   **a.** Dealers
   **b.** Brokers
   **c.** Advisers
   **d.** Comptrollers

11. _____ act as facilitators in a market, and they bring together buyers and sellers for a transaction.
   **a.** Dealers
   **b.** Brokers
   **c.** Advisers
   **d.** Comptrollers

12. _____ is the study of the allocation of scarce resources, _____ is devoted to the study of these decisions of allocation by small or individual entities, and _____ examines decisions taken together or in the aggregate.
   **a.** Macroeconomics; microeconomics; economics
   **b.** Microeconomics; economics; macroeconomics
   **c.** Economics; microeconomics; macroeconomics

**d.** Economics; macroeconomics; microeconomics

**13.** Which of the following is NOT an economy-wide macroeconomic variable used in macro-forecasting models?
**a.** inflation
**b.** unemployment
**c.** economic growth
**d.** CEO turnover

**14.** _____ is the market for short-term, low-risk, highly liquid, homogeneous securities.
**a.** The capital market
**b.** The financial market
**c.** The stock market
**d.** The money market

**15.** _____ are short-term debt instruments issued by the federal government.
**a.** Treasury bills
**b.** Treasury notes
**c.** Treasury bonds
**d.** Federal Reserve notes

**16.** _____ is a short-term, unsecured security issued by corporations and financial institutions to meet short-term financing needs such as inventory and receivables.
**a.** A Treasury bill
**b.** Commercial paper
**c.** A negotiable certificate of deposit
**d.** A Treasury note

**17.** _____ are US government debt instruments with maturities of 2, 3, 5, 7, or 10 years.
**a.** Federal funds
**b.** Federal Reserve notes
**c.** Treasury notes
**d.** Treasury bonds

**18.** _____ investments tend to have _____ risk and _____ expected returns.
**a.** Long-term; less; smaller
**b.** Long-term; greater; greater
**c.** Short-term; greater; smaller
**d.** Short-term; less; greater

**19.** _____ value is what a consumer pays for a product. _____ value is what a consumer is willing to pay for a product.
**a.** Market; Economic
**b.** Economic; Market
**c.** Book; Market
**d.** Economic; Book

## Review Questions

**1.** Identify and briefly define the three areas of study in finance.

**2.** Identify the three focal areas in *business finance.*

**3.** Define each of the following types of risk:
- inflation risk

- diversifiable risk
- non-diversifiable risk
- political risk

4. Identify three common components of good financial planning.
5. The Concepts in Practice feature in Section 1.3 discusses the importance of data for decision-making. List at least three of the ways the article suggests managers can use financial statements.
6. Describe the role of a financial analyst in a financial institution such as a bank or investment company.
7. Is a dealer or a broker more likely to be a market maker? In your answer, define the activities of a market maker.
8. How can an understanding of micro- and macroeconomic factors aid in small business decision-making?
9. We measure market capitalization by multiplying the number of shares of stock outstanding by the current price per share. Go to finance.yahoo.com and determine the market capitalization of Nike, Tesla, and Walmart. Which company has the greatest market capitalization? Which company has the highest level of sales? If these are not the same companies, why do you think the company with the lower sales level has greater market capitalization?

## Video Activity

### Why Climate Change Means New Risk for US Financial Markets

Access multimedia content (http://openstax.org/books/principles-finance/pages/1-video-activity)

1. Cite some examples that the video used to demonstrate the effect of climate change on the value of property and businesses. Now, identify examples of environmental disasters that you are personally familiar with. How have businesses in your community adapted in response to climate change?
2. Do you agree or disagree with the following statement: "The young people of today are the investors of tomorrow, and they will prioritize environmental impact in their investment choices." How do you think your investing future will be altered by climate change? Do you agree that environmental changes are a legitimate and measurable investment risk?

### Markets and Participants

Access multimedia content (http://openstax.org/books/principles-finance/pages/1-video-activity)

Robinhood is a mobile trading platform for stocks, bonds, and options. The company has transformed the security trading industry by introducing commission-free trades and simplifying the trading process with its intuitive mobile app. However, as this *Wall Street Journal* video about Robinhood explains, the company and its products are not without controversy.

3. Have you ever traded financial securities? If so, which trading platform(s) have you used? If you have traded using another platform, how does your trading experience compare to that described in the video? If you have not traded securities, discuss how the Robinhood app affects your willingness to try trading.
4. At the end of the video, one interviewee viewed Robinhood as a gateway trading platform, but not a platform for serious traders. The other saw Robinhood as a means to level the playing field for all interested investors. What are your thoughts on the Robinhood trading app? Do you agree that option trading should be more restricted than the video implies?

2

# Corporate Structure and Governance

**Figure 2.1** The legal structure of any business will have a substantial impact on its operations. (credit: modification of work "New Board Room at 2 Broadway" by Metropolitan Transportation Authority/Patrick Cashin/flickr, CC BY 2.0)

## Chapter Outline


**2.1** Business Structures
**2.2** Relationship between Shareholders and Company Management
**2.3** Role of the Board of Directors
**2.4** Agency Issues: Shareholders and Corporate Boards
**2.5** Interacting with Investors, Intermediaries, and Other Market Participants
**2.6** Companies in Domestic and Global Markets


## Why It Matters

When someone opens a business, it is because they want to fulfill important personal financial goals. In publicly traded companies, managers and employees work on behalf of the shareholders, who own the business through their ownership of company stock. These managers and employees have an ongoing obligation to pursue projects, policies, and corporate investments that will increase or promote stockholder value over the long term. Although many companies focus on financially related goals, such as growth, earnings per share, and market share, the main financial goal is to create value for investors.

Keep in mind that a company's stockholders are not just an abstract group. Like the sole business owner, they are individuals who have chosen to invest their hard-earned cash in a company. They are looking for a return on their investment in order to meet their own personal long-term financial goals, which might be saving for retirement, a new home, or college education for their children.

In addition to increasing value, it is also important to realize that a firm has important nonfinancial goals. Some examples of these might include the following:

- Expanding sales to existing customers
- Increasing customer loyalty to the weaker brands
- Developing new products for current and potential customers
- Becoming international by setting up an online ordering service

- Improving customer satisfaction with customer services

If managers are to help stockholders maximize their wealth, they must know how that wealth is determined in the first place. One of the main concepts in finance is that the value of any asset is determined by the present value of the stream of cash flows that the asset will provide to its owners over the course of time. In subsequent chapters, we will also be covering stock valuation in depth, and we will see that stock prices are based on cash flows expected in future years, not only on those coming in at the present time.

For these reasons, stock price maximization, which leads directly to maximizing shareholder wealth, requires us to take a long-term view of company operations. It is also important to realize that managerial actions that affect a company's value may not immediately be reflected in the price of a company's stock but rather will become evident in the long-term prospects of the organization.

In the case of privately held companies, smaller firms, and sole proprietorships, there are no shareholders. However, attention to long-term growth and maximizing the value of a firm is just as important a goal to the owners, who are also usually senior management with the company.

# 2.1 Business Structures

## Learning Outcomes

By the end of this section, you will be able to:

- Identify the business form created by most organizations.
- Contrast the advantages and disadvantages that the corporate form has over sole proprietorships.
- Contrast the advantages and disadvantages that the corporate form has over partnerships.
- List and describe characteristics associated with a hybrid business structure.

## The Most Common Types of Business Organization

The functions of most executive management teams are very similar for most businesses, and they will not differ in any significant manner based on how they may be structured or organized. However, the legal structure of any company will have a substantial impact on its operations, and it therefore deserves a significant amount of analysis and discussion. The four most common forms of business organizations are the following:

1. Sole proprietorships
2. Partnerships
3. Corporations
4. Hybrids, such as limited liability companies (LLCs) and limited liability partnerships (LLPs)

The vast majority of businesses take the form of a proprietorship. However, based on the total dollar value of combined sales, more than 80 percent of all business in the United States is conducted by a **corporation**.[1] Because corporations engage in the most business, and because most successful businesses eventually convert into corporations, we will focus on corporations in this chapter. However, it is still important to understand the legal differences between different types of firms and their advantages and disadvantages.

## Sole Proprietorships

A proprietorship is typically defined as an unincorporated business owned by a single person. The process of forming a business as a **sole proprietor** is usually a simple matter. A business owner merely decides to begin conducting business operations, and that person is immediately off and running. Compared to other forms of business organizations, proprietorships have the following four important advantages:

1. They have a basic structure and are simple and inexpensive to form.

1 Aaron Krupkin and Adam Looney. "9 Facts about Pass-Through Businesses." Brookings. The Brookings Institution, May 15, 2017. https://www.brookings.edu/research/9-facts-about-pass-through-businesses

2. They are subject to relatively few government rules and regulations.
3. Taxation on sole proprietorships is far simpler than on other organizational forms. There are no separate taxes associated with a sole proprietorship, as there are with corporations. Sole proprietors simply report all their business income and losses on their personal income tax returns.
4. Controlling responsibilities of the firm are not divided in any way. This results in less complicated managerial decisions and improved timeliness of necessary corrective actions.

However, despite the ease of their formation and these stated advantages, proprietorships have four notable shortcomings:

1. A sole proprietor has unlimited personal liability for any financial obligations or business debts, so in the end, they risk incurring greater financial losses than the total amount of money they originally invested in the company's formation. As an example, a sole proprietor might begin with an initial investment of $5,000 to start their business. Now, let's say a customer slips on some snow-covered stairs while entering this business establishment and sues the company for $500,000. If the organization loses the lawsuit, the sole proprietor would be responsible for the entire $500,000 settlement (less any liability insurance coverage the business might have).
2. Unlike with a corporation, the life of the business is limited to the life of the individual who created it. Also, if the sole proprietor brings in any new equity or financing, the additional **investor**(s) might demand a change in the organizational structure of the business.
3. Because of these first two points, sole proprietors will typically find it difficult to obtain large amounts of financing. For these reasons, the vast majority of sole proprietorships in the United States are small businesses.
4. A sole proprietor may lack specific expertise or experience in important business disciplines, such as finance, accounting, taxation, or organizational management. This could result in additional costs associated with periodic consulting with experts to assist in these various business areas.

It is often the case that businesses that were originally formed as proprietorships are later converted into corporations when growth of the business causes the disadvantages of the sole proprietorship structure to outweigh the advantages.

## Partnerships

A **partnership** is a business structure that involves a legal arrangement between two or more people who decide to do business as an organization together. In some ways, partnerships are similar to sole proprietorships in that they can be established fairly easily and without a large initial investment or cost.

Partnerships offer some important advantages over sole proprietorships. Among them, two or more partners may have different or higher levels of business expertise than a single sole proprietor, which can lead to superior management of a business. Further, additional partners can bring greater levels of investment capital to a firm, making the process of initial business formation smoother and less risky.

A partnership also has certain tax advantages in that the firm's income is allocated on a pro rata basis to the partners. This income is then taxed on an individual basis, allowing the company to avoid corporate income tax. However, similar to the sole proprietorship, all of the partners are subject to unlimited personal liability, which means that if a partnership becomes bankrupt and any partner is unable to meet their pro rata share of the firm's liabilities, the remaining partners will be responsible for paying the unsatisfied claims.

For this reason, the actions of a single partner that might cause a company to fail could end up bringing potential ruin to other partners who had nothing at all to do with the actions that led to the downfall of the company. Also, as with most sole proprietorships, unlimited liability makes it difficult for most partnerships to raise large amounts of capital.

## Corporations

The most common type of organizational structure for larger businesses is the corporation. A corporation is a legal business entity that is created under the laws of a state. This entity operates separately and distinctly from its owners and managers. It is the separation of the corporate entity from its owners and managers that limits stockholders' losses to the amount they originally invest in the firm. In other words, a corporation can lose all of its money and go bankrupt, but its owners will only lose the funds that they originally invested in the company.

Unlike other forms of organization, corporations have unlimited lives as business entities. It is far easier to transfer shares of stock in a corporation than it is to transfer one's interest in an unincorporated business. These factors make it much easier for corporations to raise the capital necessary to operate large businesses. Many companies, such as Microsoft and Hewlett-Packard, originally began as proprietorships or partnerships, but at some point, they found it more advantageous to adopt a corporate form of organization as they grew in size and complexity.

An important disadvantage to corporations is income taxes. The earnings of most corporations in the United States are subject to something referred to as double taxation. First, the corporation's earnings are taxed; then, when its after-tax earnings are paid out as dividend income to **shareholders (stockholders)**, those earnings are taxed again as personal income.

It is important to note that after recognizing this problem of double taxation, Congress created the **S corporation**, designed to aid small businesses in this area. S corporations are taxed as if they were proprietorships or partnerships and are exempt from corporate income tax. In order to qualify for S corporation status, a company can have no more than 100 stockholders. Thus, this corporate form is useful for relatively small, privately owned firms but precludes larger, more diverse organizations. A larger corporation is often referred to as a **C corporation**. The vast majority of small corporations prefer to elect S status. This structure will usually suit them very well until the business reaches a point where their financing needs grow and they make the decision to raise funds by offering their stock to the public. At such time, they will usually become C corporations. Generally speaking, an S corporation structure is more popular with smaller businesses because of the likely tax savings, and a C corporation structure is more prevalent among larger companies due to the greater flexibility in raising capital.

## Hybrids: Limited Liability Corporations and Partnerships

Another form of business organization is the **limited liability corporation (LLC)**. This type of business structure has become a very popular type of organization. The LLC is essentially a **hybrid form of business** that has elements of both a corporation and a partnership. Another form of organizational structure is something called a **limited liability partnership (LLP)**, which is quite similar to the LLC in structure and in use. It is very common to see LLPs used as the organizational form for professional services firms, often in such fields as accounting, architecture, and law. Conversely, LLCs are typically used by other forms of businesses.

Similar to corporation structures, LLCs and LLPs will provide their principals with a certain amount of liability protection, but they are taxed as partnerships. Also, unlike in limited partnerships, where a senior general partner will have overall control of the business, investors in an LLC or LLP have votes that are in direct proportion to their percentage of ownership interest or the relative amount of their original investment.

A particular advantage of a limited liability partnership is that it allows some of the partners in a firm to limit their liability. Under such a structure, only designated partners have unlimited liability for company debts; other partners can be designated as limited partners, only liable up to the amount of their initial contribution. Limited partners are typically not active decision makers within the firm.

Some important differences between LLCs and LLPs are highlighted in Table 2.1.

| Limited Liability Corporation | | Limited Liability Partnership | |
|---|---|---|---|
| **Advantages** | **Disadvantages** | **Advantages** | **Disadvantages** |
| Fewer restrictions on eligibility (only one member allowed; can be professional, although some states disallow professionals) | | | Only certain professions eligible |
| Usually more personal liability protection | Limited protection from partners' actions | Personal protection as well as protection from negligence of other partners | |
| Flexibility in taxation | Earnings included in members' personal taxes | Earnings taxed just once | Must file taxes as pass-through entity |

**Table 2.1 Advantages and Disadvantages of LLCs and LLPs**

LLCs and LLPs have gained great popularity in recent years, but larger companies still find substantial advantages in being structured as C corporations. This is primarily due to the benefits of raising capital to support long-term growth. It is interesting to note that LLC and LLP organizational structures were essentially devised by attorneys. They generally are rather complicated, and the legal protection offered to their ownership principals may vary from state to state. For these reasons, it is usually necessary to retain a knowledgeable lawyer when establishing an organization of this type.

Obviously, when a company is choosing an organizational structure, it must carefully evaluate the advantages and disadvantages that come with any form of doing business. For example, if an organization is considering a corporation structure, it would have to evaluate the trade-off of having the ability to raise greater amounts of funding to support growth and future expansion versus the effects of double taxation. Yet despite such organizational concerns with corporations, time has proven that the value of most businesses, other than relatively small ones, is very likely to be maximized if they are organized as corporations. This follows from the idea that limited ownership liability reduces the overall risks borne by investors. All other things being equal, the lower a firm's risk, the higher its value.

Growth opportunities will also have a tremendous impact on the overall value of a business. Because corporations can raise financing more easily than most other types of organizations, they are better able to engage in profitable projects, make investments, and otherwise take superior advantage of their many favorable growth opportunities.

The value of any asset will, to a large degree, depend on its liquidity. *Liquidity* refers to asset characteristics that enable the asset to be sold or otherwise converted into cash in a relatively short period of time and with minimal effort to attain fair market value for the owner. Because ownership of corporate stock is far easier to transfer to a potential buyer than is any interest in a business proprietorship or partnership, and because most investors are more willing to invest their funds in stocks than they are in partnerships that may carry unlimited liability, an investment in corporate stock will remain relatively liquid. This, too, is an advantage of a corporation and is another factor that enhances its value.

### LINK TO LEARNING

#### Amazon

Most people are surprised to learn than Amazon, the largest online retailer, is set up as an LLC.

Amazon.com Services LLC is set up as a subsidiary of the larger Amazon.com Inc. Take a look at the Amazon LLC company profile provided by Dun & Bradstreet (https://openstax.org/r/company-profiles-amazon). Why do you think such a large corporation is set up as an LLC?

## Incorporating a Business

Many business owners decide to structure their business as a corporation. In order to begin the process of incorporation, an organization must file a business registration form with the US state in which it will be based and carry on its primary business activities. The document that must be used for this application is generally referred to as the **articles of incorporation** or a corporate charter. Articles of incorporation are the single most important governing documents of a corporation. The registration allows the state to collect taxes and ensure that the business is complying with all applicable state laws.

The exact form of the articles of incorporation differs depending on the type of corporation. Some types of articles of incorporation include the following:

- **Domestic corporation** (in state)
- **Foreign corporation** (out of state or out of country)
- **Close (closely held) corporation**
- **Professional corporation**
- **Nonprofit corporation** (several different types of nonprofits)
- **Stock corporation**
- **Non-stock corporation**
- **Public benefit corporation**

It is important to note that articles of incorporation are only required to establish a regular corporation. Limited liability corporations require what are referred to as *articles of organization* (or similar documents) to register their business with a state. Some types of limited partnerships must also register with their state. However, sole proprietorships do not have to register; for this reason, they are often the preferred organizational structure for a person who is just starting out in business, at least initially.

Articles of incorporation provide the basic information needed to legally form the company and register the business in its state. The state will need to know the name of the business, its purpose, and the people who will be in charge of running it (the **board of directors**). The state also needs to know about any stock that the business will be selling to the public. The websites of various **secretaries of state** will have information on the different types of articles of incorporation, the requirements, and the filing process.

# 2.2 Relationship between Shareholders and Company Management

### Learning Outcomes

By the end of this section, you will be able to:

- Explain the difference between principals and agents.
- List and discuss various stakeholders associated with a company and its operations.
- Explain how management impacts the operations and future of a company.

## Stakeholders

A **stakeholder** is any person or group that has an interest in the outcomes of an organization's actions. Stakeholders include employees, customers, shareholders, suppliers, communities, and governments. Different stakeholders have different priorities, and companies often have to make compromises to please as many stakeholders as possible.

## Shareholders' Roles and Composition

A shareholder or stockholder can be a person, company, or organization that holds stock in a given company. Shareholders typically receive dividends if the company does well and succeeds. They are entitled to vote on certain company matters and to be elected to a seat on the board of directors. One advantage of being a shareholder is that creditors cannot compel shareholders to pay for any of the company's financial obligations or debts. However, being a shareholder includes responsibilities such as appointing the company's directors, deciding on director compensation, setting limits on directors' power, and monitoring and approving the company's financial statements.

### Types of Shareholders

There are two types of shareholders: common shareholders and preferred shareholders. Common shareholders are any persons who own a company's common stock. They have the right to control how the company is managed, and they have the right to bring charges if management is involved in activities that could potentially harm the organization. Preferred shareholders own a share of the company's preferred stock and have no voting rights or involvement in managing the company. Instead, they receive a fixed amount of annual dividends, apportioned before the common shareholders are paid. Though both common shareholders and preferred shareholders see their stock value increase with the positive performance of the company, common shareholders experience higher capital gains and losses.

Shareholders and directors are two different entities, although a director can also be shareholder. The shareholder, as already mentioned, is a part owner of the company. A director, on the other hand, is the person hired by the shareholders to perform oversight and provide strategic policy direction to company management.

### The Differences between a Shareholder and a Stakeholder

The terms *shareholder* and *stakeholder* mean different things. A shareholder is an owner of a company because of the shares of stock they own. Stakeholders may not own part of the company, but they are in many ways equally dependent on the performance of the company. However, their concerns may not be financial. For example, a chain of hotels in the United States that employs thousands of people has several classes of stakeholders, including employees who rely on the company for their jobs and local and national governments that depend on the taxes the company pays.

Before a company becomes public, it is a private company that is run, formed, and organized by a group of people called *subscribers*. A **subscriber** is a member of the company whose name is listed in the memorandum of association. Even when the company goes public or they depart from the company, subscribers' names continue to be written in the public register.

## Role of Management

Corporations are run at the highest level by a group of senior managers referred to as the board of directors (BOD). The BOD is ultimately responsible for providing oversight and strategic direction as well as overall supervision of the organization at its highest managerial level. From an operational standpoint, the practical day-to-day management of a company comprises of a team of several mid-level managers, who are responsible for providing leadership to various departments in the company. Such managers may often have different functional roles in a business organization. The primary roles of any management group involve setting the objectives of the company; organizing operations; hiring, leading, and motivating employees; and overseeing operations to ensure that company goals are continually being met.

It is also important that managers have a long-term focus on meeting growth targets and corporate objectives. Unfortunately, there have been many examples of companies where the managerial focus was shifted to short-term goals—quarterly or fiscal year earnings estimates or the current price of the company stock—for personal reasons, such as increased bonuses and financial benefits. Such short-term thinking is

often not in the best interest of the long-term health and objectives of companies or their shareholders.

# 2.3 Role of the Board of Directors

## Learning Outcomes

By the end of this section, you will be able to:

- Describe the oversight functions performed by boards.
- Define an independent board member.
- Compare arguments for and against having independent board members.
- Describe ways boards can become diverse.

## Functions of a Board of Directors

A board of directors is a group of people who are elected to represent shareholders, and these directors are then ultimately responsible for running the company. Every public company is legally required to install a board of directors. Nonprofit organizations and many private companies often establish a board of directors as well, even if they are not legally required to do so.

The board is responsible for protecting shareholders' interests, establishing management policies, overseeing the corporation or organization, and making decisions about important issues. The board of directors acts as a fiduciary for shareholders. The board is also tasked with a number of other responsibilities, including setting company goals, creating dividend and stock option policies, hiring and firing chief executive officers (CEOs), and ensuring that the company has the resources it needs to perform well.

### Basic Structure of a Board of Directors

The bylaws of a company or organization determine the structure, responsibilities, and powers given to a board of directors. The bylaws also determine how many board members there are, how the members are elected, and how frequently the board members meet.

The board must represent shareholder and management interests, so it is best for the board to include both internal and external members. Usually, there is an internal director and an external director. The internal director is a member of the board who is involved with the daily workings of the company and manages the interests of shareholders, officers, and employees. The external director represents the interests of those who function outside of the company. The CEO often serves as the chairman of the company's board of directors.

**Figure 2.2 Corporate Boardroom** (credit: "495 Express Lanes Board Room" by Fairfax County Chamber of Commerce/flickr, CC BY 2.0)

### International Structure of a Board of Directors

The structure of a board of directors varies more outside of the United States. In Asia and the European Union, there are commonly executive and supervisory boards. The executive board is made up of company insiders who are elected by employees and shareholders. In most cases, the executive board is headed by the company CEO or a managing officer. The supervisory board oversees daily business operations and acts much like a typical US board of directors. The chair of the board varies, but the board is always led by someone other than the prominent executive officer.

## Oversight: Corporate Governance

Corporate governance is a discipline that focuses on how a company conducts its business and the various controls that are implemented to ensure proper procedures and ethical behavior.

Although many companies and managers do operate with a fair and honest philosophy, others will try to exploit the temporary benefits of actions that fall outside ethical behavior. Companies do not always adhere to laws. You may have seen or read news stories about false reporting of earnings, failure to reveal financial information, or payments of large bonuses to top executives shortly after a company files for bankruptcy.

In one infamous example, the insurance giant AIG paid for a lavish trip to California for top employees of the company immediately after declaring that the company was insolvent. It asked for and received financial support from the US government in the bailout of 2008.[2]

At other times, a company may cross the line between legal and illegal and violate the law in order to increase profits. Because of the potential for human self-interest and greed, governments have enacted laws and regulations that require specific actions of a company or restrict its activities in an effort to ensure fair competition and ethical behavior.

Often, Congress enacts laws and regulations in response to major economic or other highly visible events. Following the great market crash of 1929, the US government created a new set of rules and regulations governing the issuing and trading of securities, the Securities Act of 1933 and the Securities Exchange Act of 1934. The government also created the **Securities and Exchange Commission (SEC)** to oversee these laws and regulations.

The new laws required that firms make available specific financial information to current owners and prospective owners and that the SEC approve the initial sale of securities to the public. More recently, following a series of major ethical lapses at some firms, the US government enacted new legislation in 2002. One of the most sweeping acts is the Sarbanes-Oxley Act (SOX), which requires, among other things, the following:

- That the CEO and chief financial officer (CFO) must attest to the fairness and accuracy of the company's financial reporting
- That the company implements and maintains an effective structure of internal controls responsible for the reporting of financial results
- That the company and an external public accounting firm confirm the effectiveness of the controls over the most recent fiscal year

In addition, SOX created the Public Company Accounting Oversight Board, outlining the prohibited activities of auditors. It also set a requirement that the SEC issue new rulings that establish compliance with the act.

### Board of Directors Oversight and Corporate Governance

Because of the widely publicized control breakdowns at Wells Fargo Bank and recent regulatory actions, boards of directors of public companies and financial institutions have been directed to improve oversight and **corporate governance**. Boards are evolving from focusing primarily on the needs of top key individuals to

2 Scott Vogel. "You Paid for It: AIG's Retreat Destination, Up Close." *Washington Post*. October 9, 2008. http://voices.washingtonpost.com/travellog/2008/10/disaster_tourism_comes_to_cali.html

considering broader aspects of ethics, values, and corporate culture. Boards now oversee the monitoring systems being put in place and may take on direct responsibilities related to senior management.

## The Role of the Audit Committee

A strong independent audit committee (AC) is an important part of the corporate governance efforts of any firm. The AC is formed by the board of directors as a separately chartered subcommittee of the board of directors. It reports regularly to the BOD and assists the board by assuming responsibilities for critical corporate financial matters, such as reviewing audit plans and findings, approving external public accountants, and coordinating the efforts of both internal and external financial reviews and audits. The audit committee provides expertise in all financial and accounting matters for a company, and it is therefore a critical part of a company's corporate governance efforts.

Some important functions of the audit committee include

- confirming the accuracy of the firm's financial reporting;
- verifying that systems of internal control and risk management are operating effectively;
- ensuring compliance with legal and regulatory requirements;
- verifying the qualifications, independence, and performance of the external public auditing firm; and
- coordinating the activities and performance of the internal audit function.

The role of the audit committee has significantly expanded over the years, and it has become exceedingly important with the enactment of the Sarbanes-Oxley Act. Due to this increase in importance and recognition, several boards have shifted some of the audit committee's responsibilities to separately chartered committees in order to create a balance of duties and ensure that those duties are effectively focused on and efficiently executed. Some of these additional committees have been known to include a compensation committee, a disclosure committee, and a governance committee, and they all have related objectives that need to be documented within the charter of each of the individual committees. It is important for the different committees to have close working relationships so that the audit committee can help each one fulfill its responsibilities to senior management, the greater board of directors, shareholders, and other stakeholders.

The audit committee performs an internal audit to review the organization's corporate governance process and to communicate any recommendations for changes. The audit committee will usually follow up and monitor the process put in place to implement any changes or necessary improvements. As with any other corporate function, the audit committee's role is greatly affected by the legal, institutional, financial, cultural, and political circumstances that impact the company.

## Importance of Improving Oversight and Governance

It is crucial to today's corporate environment that firms do not lose sight of achieving and maintaining strong and efficient oversight and governance. This is true despite the litany of other important items on the busy agendas of most boards.

Keeping a focus on the critical ethics of management, as well as the traditional focus on the importance of ethics to the overall organization, is not only timely in this day and age but also sound business practice. The importance of establishing a comprehensive system of checks and balances cannot be overemphasized. Beginning with the chief executive officer, these checks and balances need to progress through senior management, and they ultimately include the board of directors itself. Similar checks and balances need to then filter down though the rest of the entire firm. By taking the appropriate steps to improve corporate oversight and governance, overall business risk can be mitigated and future operational problems reduced. Additionally, such steps can lead to the positive effects of achieving sustainable operational and financial benefits for a company and its shareholders.

LINK TO LEARNING

PepsiCo

PepsiCo is a global leader in the food and beverage industry. It has also been noted for its excellence in corporate governance. Take a look at the PepsiCo website (https://openstax.org/r/pepsico). Why do you think the company has won numerous awards and was featured in Fortune's annual Blue Ribbon Companies list for 2021?

## The Importance of Independence in Boards of Directors

An independent board of directors is composed of individuals who have no material interest in the company other than their directorship. They maintain their independence by only accepting compensation from the company for their BOD services. They also have their own information sources, instead of relying on information provided by senior management of the company. It is considered a corporate governance best practice to have independent members serve on boards of directors for both publicly and privately held companies.

In most cases, board members have no affiliation with activities or organizations that could result in conflicts of interest. An example of this might be a scenario in which a board is considering the formation of a partnership or alliance with an organization that is directly associated with one of its board members. In such an instance, a director might be excused from participating in that decision process, particularly if it is clear that it would lead to potential conflict.

A board with a majority of independent directors can bring expertise and objectivity, which

- helps assure ownership that the company is being run legally, ethically, and in the best interest of shareholders;
- allows for both independence and objectivity regarding senior managerial representatives and limits situations in which a key decision maker might have a vested interest or an "ax to grind"; and
- enables board members to advance discussions with no hidden agendas for self-advancement or other self-profiting motives.

## The Importance of Diversity in Boards of Directors

As mentioned earlier, diversity can be an important quality for any board of directors. Increasingly over recent years, corporate management has begun to appreciate the value of diversity in boards of directors. This has resulted in a significant increase in the total number of women and people of color in boardrooms in the United States. However, many business observers believe that corporate governance practices have a long way to go in this respect. Increasing representation has now grown to become a high priority for most businesses and organizations around the world.

Board members face many challenges in making decisions effectively and efficiently as possible. Because of such challenges, the potential objective of diversifying the boardroom competes with other worthy topics and objectives such as improving cybersecurity, advancing customer service, identifying and reducing risk, improving community relations, and positioning strategically within an industry. This has left corporate governance experts and researchers in a situation where they find themselves "playing catch-up" to adequately diversify.

# 2.4 Agency Issues: Shareholders and Corporate Boards

## Learning Outcomes

By the end of this section, you will be able to:

- Define the concept of agency costs.
- Discuss conflicts of interest between board members, company management, and employees.
- Define each component of ESG.
- Discuss the findings indicating how ESG policies impact stock returns.

## Agency Problems and Issues

*Agency problems* refers to conflicts that occur when an **agent** (manager) who is entrusted with following the interests of the **principal** (shareholder or owner) of an organization abuses their position to further their own personal goals. In the field of corporate finance, agency problems are often related to a conflict of interest between the management of a company and its shareholders.

For many years, this has been a very common problem that has been seen in nearly every kind of organization, irrespective of it being a church, a club, a not-for-profit organization, a multinational corporation, or any other government agency or institution. As with most problematic issues in business, agency problems can be resolved, but only if organizations are willing to take the appropriate steps to resolve them.

Every company has its own set of goals and objectives, but it is important to note that the employee and personal goals of managers may differ and may not align with the goals and objectives of stockholders (ownership). Because these differences exist, and because all parties have a desire to maximize their own wealth, agency problems can often arise, having a negative impact on company profits, stock price, and the goodwill of the shareholder base.

There are three primary types of agency problems, discussed below.

### CONCEPTS IN PRACTICE

#### Example of an Agency Problem

ABC Co. used to sell organic shampoo for $15, but the stockholders of ABC lobbied for an increase in the selling price of the shampoo from $15 to $18. This was to increase earnings and, ultimately, their own personal wealth through an uptick in stock price. However, as a result of this unnecessary rise in the price of the shampoo, customers were disappointed, and a majority of them wound up boycotting the product. Additionally, some of the consumers who continued to purchase the product noticed a decline in the overall quality of the shampoo and were also very disappointed. In this scenario, agency problems surfaced between stockholders and loyal customers of the company.

### Stockholders versus Management

Large corporations typically have a substantial number of stockholders forming their ownership. It is essential for an organization to separate the management of a company from this ownership in order to avoid this type of agency problem.

Segregating ownership from management can be advantageous for an organization. Doing so will usually not have any effects on normal business operations. At the same time, the company can employ different experts and professionals to manage key operations of the business.

However, a drawback to this is that hiring outsiders may eventually become troublesome for shareholders. External managers who are brought into a company may end up making self-serving decisions or even

misusing company funds. This could eventually result in declining bottom line results and company share prices, which would then lead to conflicts of interests between stockholders and company management.

An example of an agency problem between management and shareholders occurred at WorldCom in 2001, when their CEO used company assets to underwrite several personal loans.[3] As a result of these inappropriate actions, the company took on additional debt that negatively impacted WorldCom's capital structure, liquidity, and ultimately its stock price. From this example, we can see how individual greed on the part of agents, executives, or corporate management can lead to significant agency problems.

## Investors versus Creditors

If a company decides to engage in risky investments and projects in order to drive organizational profitability, these increased risk levels could threaten the company's ability to service (repay) their debts, leading to possible default.

This additional risk could also result in creditors taking steps to devalue such debts, which in most cases refers to company bond issues. In the end, if these riskier projects end up failing and the company loses money, investors (bondholders) may also experience financial risk as bonds go into default or otherwise lose market value. This then becomes a potential agency problem between bondholders (investors) and creditors.

## Stockholders versus Other Stakeholders

Situations may arise in which stockholders of a firm find themselves in conflicts of interest with other stakeholders of the company. For example, employees of a firm might be asking for a general wage increase. If such a wage increase were voted down by stockholders, this could result in key employees departing the organization, eventually leading to poorer business results and the dissatisfaction of other stakeholders in the company as company profits decline. In such an example, we see the agency problem of stockholders versus other stakeholders.

A more specific example of such an agency problem occurred in 2011, when Oregon-based food and gift basket company Harry & David was forced to file for bankruptcy.[4] This was a direct result of the company being purchased through a leveraged buyout that left the company saddled with a tremendous amount of debt. However, the most important factor leading to the company's failure was the actions of Steven Heyer, who was a friend of the new owners and had been hired as CEO. Heyer, who was awarded an exorbitant executive salary, was also allowed to sink the company into further debt. Harry & David has since emerged from bankruptcy under new leadership. But this example should serve as a cautionary tale of what can happen when stockholders are able to put their interests ahead of those of other stakeholders in a corporate environment.

### CONCEPTS IN PRACTICE

#### Infamous Agency Problems

**Enron**

Enron is one particularly infamous example of an agency problem. Enron's directors were responsible for protecting and promoting investor interests, but they failed to carry out their regulatory and oversight responsibilities, enabling the company to venture into illegal activity. The company's resulting accounting scandal resulted in billions of dollars in losses to its investors.

At one time, Enron had been one of the largest companies in the United States. Despite being a multibillion-

3 Anshita Kohli. "Worldcom Scam: The Fall of the Biggest US Telecommunication Company." The Company Ninja. JD Learning Ventures, May 26, 2020. https://thecompany.ninja/worldcom-scam/
4 Beth Kowitt. "Harry & David's Failed Mr. Fix-It." *Fortune*. April 1, 2011. https://fortune.com/2011/04/01/harry-davids-failed-mr-fix-it/

dollar company, Enron began losing money in 1997. It had also started incurring a tremendous amount of debt. Fearing a drop in stock prices, Enron's management team tried to disguise the problems by misrepresenting them through inappropriate accounting methods, which resulted in confusing and misleading financial statements.

Disaster started to unfold in 2001, when common stock prices fell from $90 to under $1 per share. The company filed for bankruptcy in December 2001, and criminal charges were brought against several key Enron employees, including former CEO Kenneth Lay and former CFO Andrew Fastow. Jeffrey Skilling was subsequently named CEO in February 2001, but he ended up resigning six months later.

**Bernard L. Madoff Investment Securities LLC**

Ponzi schemes are common examples of the agency problem. **Agency theory** claims that a lack of oversight and incentive alignment greatly contributes to these problems. Many investors fall into Ponzi schemes thinking that taking fund management outside a traditional banking institution reduces fees and saves money.

Even though established financial institutions reduce risk by providing oversight and enforcing legal practices, some Ponzi schemes simply involve taking advantage of consumer suspicions about the banking industry and financial markets. In this type of environment, the consumer cannot ensure that an agent is acting in their best interest. Investments are made under limited or, in many cases, completely nonexistent oversight.

Bernie Madoff's scam is probably one of the most infamous examples of a Ponzi scheme. Madoff's fraud started with friends, relatives, and acquaintances in New York, but it ultimately grew to encompass major charities such as Hadassah, universities such as Tufts and Yeshiva, institutional investors, and wealthy families in Europe, Latin America, and Asia. The cash losses of Madoff's scheme were recently estimated to be between $17 billion and $20 billion. The returns he promised were higher than what most investment firms and banks were offering—so promising that almost all of his investors ignored any concerns they may have had and basically looked the other way. Madoff paid for any redemption requests with money that had been newly invested.

Madoff's Ponzi scheme fell apart when he could no longer pay his investors. He was criminally charged, convicted, and given a 150-year prison sentence. Madoff died in April 2021 while serving his prison term.

(Sources: Diana B. Henriques. "Bernard Madoff, Architect of Largest Ponzi Scheme in History, Is Dead at 82." *New York Times*. April 14, 2021. https://www.nytimes.com/2021/04/14/business/bernie-madoff-dead.html; Chase Peterson-Withorn. "The Investors Who Had to Pay Back Billions in Ill-Gotten Gains from Bernie Madoff's Ponzi Scheme." *Forbes*. April 14, 2021. https://www.forbes.com/sites/chasewithorn/2021/04/14/the-investors-who-had-to-pay-back-billions-in-ill-gotten-gains-from-bernie-madoffs-ponzi-scheme/; Adam Hayes. "The Agency Problem: Two Infamous Examples." Investopedia. Dotdash, updated April 15, 2021. https://www.investopedia.com/ask/answers/041315/what-are-some-famous-scandals-demonstrate-agency-problem.asp)

## How to Resolve Agency Problems

Ultimately, agency problems result from the differences among the interests of a company's management, other stakeholders of the firm, and its ownership or stockholders. When perpetuated, these differences may eventually result in lasting conflicts of interest. In order for companies to avoid such problems, it is imperative that they address the underlying problems of these differences. This will help ensure that normal business operations are not being adversely impacted by the agency problem.

While there is no surefire way to resolve all conflicts of interest and agency problems, some measures that can

help mitigate such issues include the following:

- Offering incentives to management for strong performance and ethical behavior
- Awarding decision makers with stock packages, commissions, and other long-term compensation packages to encourage long-term thinking and matching of company objectives with shareholders' priorities
- Penalizing poor performance, shortsightedness, and unethical behavior

The prevailing belief in agency theory is that when a business creates organizational incentives that encourage hard work on projects that will benefit the company in both the short and long term, more employees will be encouraged to act in the business's best interest.

Another means of resolving agency problems is through a hostile takeover of the organization. Even the threat of such a takeover may be effective in reducing or eliminating these conflicts of interest. A hostile corporate takeover tends to unify and discipline a management or agent group, thus fostering a union of agent and shareholder interests. When such a potential threat or outright ownership change is introduced to a company, its managers are more likely to act in the best long-term interests of the shareholders in order to maintain their leadership positions within the company.

By better aligning *agent* (management) and *principal* (ownership) goals, agency theory attempts to bridge any gulfs among employees, employers, and stakeholders that are created by the principal-agent problem. While it is recognized as being nearly impossible for companies to eliminate the ongoing agency problem, it is also recognized that it is possible to minimize its negative effects.

## Impact of ESG Ratings

In recent years, many publicly traded companies, as well as many that are privately owned, are being evaluated and rated according to environmental, social, and governance **(ESG)** factors. These ratings and evaluations are primarily conducted by third-party organizations. As a result, the investment community is using these reports and ratings to an ever-increasing degree in order to measure and assess corporate ESG factors and performance.

Environmental, social, and governance issues have become an important part of the investment community's evaluation of publicly traded companies. Each component of what is now referred to as ESG has equal importance in ongoing corporate evaluations, as per Figure 2.3 below. It is critical for the senior management of any corporation to stay abreast of any and all ESG issues as they arise and take immediate corrective action when necessary.

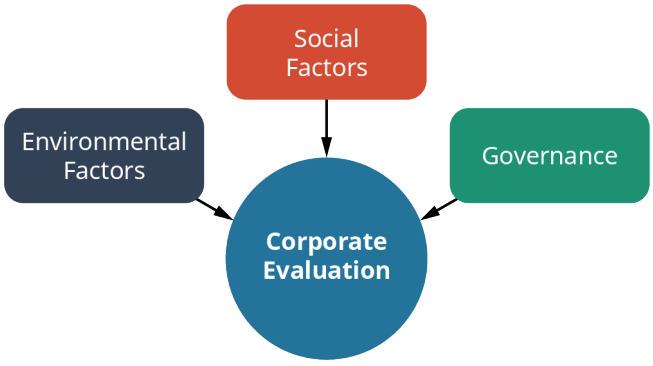


**Figure 2.3 Importance of ESG Factors to a Business Concern**

ESG measurements and assessments have become very important to firms, as they often become the basis of formal and informal buy recommendations by investment professionals. ESG ratings were originally developed to assist in determining the general risk of ESG factors for any public company, but they have since grown to become unique scores used by investors to gauge the potential attractiveness of investment in the subject company. Because of the nature of these factors, firms that are rated with high ESG metrics are believed to

represent superior investments and to have proactive management teams focused on creating long-term value of company stock.

Thus, with investors increasingly using ESG scores to form their investment strategies, the consequences of a poor rating can have a negative impact on a firm's share price and result in substantial problems. In any case, it is important to note that ESG is only a starting point from which it is possible to gather indicators on a business and its direction. In the end, it does not present the entire story of a firm. Any investment decisions about the company in question should include a significant amount of additional data.

# 2.5 Interacting with Investors, Intermediaries, and Other Market Participants

## Learning Outcomes

By the end of this section, you will be able to:

- Define the investor relations function.
- Discuss how the investor relations office interacts with investors, regulators, and other corporate stakeholders.
- Describe the topics most often discussed during a quarterly conference call.
- Explain how press release information impacts company stock prices.

## Investor Relations

Within the general field of corporate public relations is a specific subdivision referred to as **investor relations (IR)**. IR involves elements of communication, marketing, and finance and is designed to control the flow of information from the management of a public corporation to its investors and stakeholders.

Because the investment community plays such a critical role in the overall growth and success of any corporation, it is imperative that firms maintain strong and open relationships with their shareholder or potential investor audience. IR was developed to take responsibility for achieving and maintaining these crucial relationships.

Investor relations are quite different from typical public relations practices. A firm's IR group must work very closely with the accounting and legal departments, as well as with members of the senior management team, such as the CEO and CFO.

As might be expected, IR has far more regulatory obligations than standard public relations functions, largely due to corporate reporting requirements enforced by the SEC and the **International Financial Reporting Standards (IFRS)**. IR became significantly more important in 2002, when the United States Congress passed the Sarbanes-Oxley Act (SOX), also known as the Public Company Accounting Reform and Investor Protection Act. This legislation resulted in requirements that dramatically increased the extent of financial reporting for any publicly traded company. SOX was enacted in an attempt to prevent the occurrence of corporate financial scandals such as the one notoriously committed by the Enron Corporation that we discussed earlier.

In summary, investor relations functions have responsibilities including, but not limited to,

- coordinating live shareholder meetings and press conferences;
- disseminating financial information to the investment community;
- conducting briefings to the financial analyst community;
- publishing the **quarterly report** and **annual report**; and
- addressing any issues that arise as a result of financial disclosure.

The best time to form an internal IR function or to engage an IR firm is when a company begins the process of becoming publicly traded through an initial public offering, or IPO.

## Quarterly Earnings Conference Calls

As a result of the Securities Exchange Act of 1934, all publicly traded companies are required to file certain financial reports with the SEC. The underlying purpose of these requirements is to provide shareholders and the investment community with important operational and financial information on a regular basis and in a transparent manner. Reports filed with the SEC include the annual Form 10-K, quarterly Form 10-Qs, and current periodic Form 8-Ks, in addition to proxy reports and certain shareholder and affiliate reporting documents. Quarterly 10-Qs are an ongoing and regular reporting requirement of publicly traded companies and are to be filed within 45 days following the end of each fiscal quarter.

Depending on a company's size and the complexity of its operation, a firm is likely to issue an earnings **press release** and conduct a **conference call** with the investment community within this same 45-day period. There is no legal requirement for companies to do either of these things, but experts in IR view these communications tools as best practice. They can add context and commentary to the reported financial results.

It is important for companies to do their planning and not enter a quarterly earnings conference call unprepared. There is a multitude of available resources for companies to analyze and review in preparation. Among such resources are industry reports prepared by government agencies; the financial reports and earnings calls of competing organizations, both within and outside of a company's primary industry; and financial research reports prepared by various covering analysts, who follow the specific company and are employed by financial brokerage firms.

## Investment Meetings and Conferences

Organizing the **annual meeting** of shareholders, investor roadshows, and investment conferences is no easy task for any corporation, though all of these audience-facing events are critical to maintaining strong relations with shareholders and the investment community. It is important to reach shareholders and investors on an almost personal basis by crafting a successful and interesting investment story. For effective investor relations, key messages supporting any ownership or potential investment case should be clear and consistent. These key messages should be embedded within the company's materials and should form the basis of presentations, the corporate website, and annual reports. They should also be reinforced via concrete examples during annual meetings, roadshows, and investor presentations.

**Figure 2.4 Quarterly Investor Relations Presentation** (credit: "MAPFRE" by Castilla y León Económica/flickr, CC BY 2.0)

Corporations have found that using senior management's time efficiently is also important to investor relations. By targeting the ownership and potential investing audience, senior executives can make the best use of their time and improve their interactions with the investing public during these events. If smaller

companies outsource the investor meeting planning process, the third-party firm should be thoroughly grounded in the client's corporate culture.

The most productive investor and shareholder meetings begin with a strong, understandable corporate introduction and continue by delivering an engaging story that demonstrates the company's successes, a track record of growth, and the high probability of favorable future prospects. Additionally, it is important for a company's senior management to end any meeting with feedback from the investor audience and set timelines for follow-up. There will always be times when something unexpected may happen and the addition of information or impromptu changes to scheduled agendas may occur. It is at times like these when understanding the body language and facial expressions of an audience can be critical in producing a favorable outcome of the meeting.

It is unlikely that the decision to invest or to remain an investor will be made based on a single corporate event, but impressions, good or bad, will certainly factor into such decisions over a period of time. Thus, it is important for IR officers to understand the importance of follow-up communication with their audience.

## Purposes of Corporate Press Releases

Press releases have always been a vital tool in the communications toolkit of an IR professional. Various social media channels are also becoming increasingly popular for delivering company information and news. However, the press release remains a standard medium for most companies to communicate corporate news, results, and ideas.

Press releases can be written with various intentions. Whether to release financial information, unveil new products or services, announce changes in management, or a host of other reasons, all communications have a different objective. Not all press releases are created equally, and they have varying degrees of effectiveness. Any press release should contain information in easy-to-understand language that is free of corporate jargon and as concise as possible. Press releases may be viewed by multiple audiences, such as customers, stakeholders, investors, potential investors, and the general public, which is vital to consider when drafting a press release.

According to PR Newswire statistics, press releases that contain multimedia content have been known to substantially increase press release views.[5] Using infographics and charts where possible and relaying the key messages in short, easy-to-digest points make a press release easier for the reader to take in. Quotes from senior management can provide valuable insight, but they should not provide any new information; they should simply extend or expand on a subject already mentioned and further back up a claim.

### LINK TO LEARNING

#### Press Releases Approved by PR Newswire

Take a look at this press release on mobile drive-in movies during the COVID-19 pandemic (https://openstax.org/r/mobile-drive-in-movies).

How would you judge this press release? Is it effective? Why or why not?

5 "Multimedia Content Distribution." PR Newswire. Cision, accessed August 27, 2021. https://www.prnewswire.com/products/multimedia-distribution-options.html

# 2.6 Companies in Domestic and Global Markets

## Learning Outcomes

By the end of this section, you will be able to:

- Explain why corporations expand beyond domestic borders.
- Determine how different strategic decisions may influence corporate performance.

## Important Differences among Domestic, International, and Global Organizations

If a company becomes global or multinational in scope, fundamental analysis of the organization by the investment community can become more complex. In order to better understand a company, it is important to determine what laws affect the company's governance process and which set of accounting rules is used to fashion its financial reports.

Domestic companies operate completely or for the most part within the borders of the United States. While such organizations may import raw materials and supplies from other nations or end up exporting their finished products to other countries around the world, in the end, these international activities represent only a very small portion of their overall business activities.

Domestic companies are typically governed by US accounting and securities laws that have been established by the SEC. Further, financial reporting for these domestic organizations is to be completed using **Generally Accepted Accounting Principles (GAAP)**.

International firms, while based in the United States, will typically maintain significant levels of international investment and conduct operations that may be quite diverse, both geographically and culturally. For such international firms, parent company accounting will usually adhere to GAAP standards. Conversely, non-US subsidiaries of such international firms may be regulated by laws dictated by their host countries. These will often differ significantly from those in the United States.

In recent years, accounting regulations in countries outside the United States have come under the jurisdiction of International Financial Reporting Standards (IFRS). It should be noted that guidelines and regulations under IFRS and those under GAAP can differ significantly. As a result of these regulatory differences, any specific divergences in accounting or governance practices between foreign subsidiaries and a US parent company should be clearly stated and disclosed in the parent company's financial reports.

Global firms have substantial operations and investments in different countries (**global markets**), and they may have no single center or basis of operational activity. In such cases, regulations for corporate governance are usually determined by the laws of the country in which the parent company has been established. While there are some global firms that report their financial statements according to GAAP standards, usually to satisfy the informational needs of US investors, most global parent companies' financials will adhere to IFRS reporting standards.

## Difference in Financial Reporting: GAAP versus IFRS

Generally Accepted Accounting Principles (GAAP) and International Financial Reporting Standards (IFRS) were designed with similar objectives in mind: to provide a common and structured set of guidelines to assist in the preparation of accurate and unbiased financial reporting for public corporations.

Yet despite these commonalities in purpose, there are important differences between them. Among these are differences in inventory accounting and reporting, guidelines for consolidation of subsidiaries, and the accounting and reporting of minority interests.

LINK TO LEARNING

GAAP and IFRS

Learn more about US GAAP reporting from the SEC website (https://openstax.org/r/corpfin-manual), and learn about international standards from the IFRS website (https://openstax.org/r/ifrs-org).

## SEC Reporting and EDGAR

**EDGAR (Electronic Data Gathering, Analysis, and Retrieval system)** is the primary system for collecting and indexing documents submitted by companies to the SEC under the Securities Act of 1933, the Securities Exchange Act of 1934, the Trust Indenture Act of 1939, and the Investment Company Act of 1940.

LINK TO LEARNING

EDGAR System

The SEC's EDGAR system (https://openstax.org/r/edgar-html) contains millions of corporate and individual filings. It benefits investors, corporations, and the US economy overall by increasing the efficiency, transparency, and fairness of the securities markets. The system processes about 3,000 filings per day, serves up 3,000 terabytes of data to the public annually, and accommodates 40,000 new filers per year on average.[6]

6 "About EDGAR." US Securities and Exchange Commission. Modified March 23, 2021. https://www.sec.gov/edgar/about

# Summary

## 2.1 Business Structures

The most common forms of business organizations are sole proprietorships, partnerships, corporations, and hybrids. There are advantages and disadvantages to each type of organization involving ease of formation, tax requirements, and personal liabilities. The most common type of organization for larger businesses is the corporation, the establishment of which involves filing articles of incorporation.

## 2.2 Relationship between Shareholders and Company Management

A stakeholder is any individual or group that has an interest in the outcomes of an organization's actions. Shareholders are relevant to a corporation form of business because they own stock in the corporation. The board of directors of a company is ultimately responsible to shareholders for effectively running the business.

## 2.3 Role of the Board of Directors

The board of directors acts as a fiduciary for shareholders. The board is also tasked with a number of other responsibilities, including setting company goals, creating dividend and stock option policies, hiring and firing CEOs, and ensuring that the company has the resources it needs to perform well. Diversity and experience play important roles in corporate governance and in the strength and effectiveness of a board of directors.

## 2.4 Agency Issues: Shareholders and Corporate Boards

Issues and conflicts of interest might arise between shareholders (public ownership) and senior management, including C-level executives and the board of directors. Although there is no definite way to resolve all conflicts of interest, some measures that can help mitigate problems include offering incentives for strong performance and ethical behavior and awarding decision makers with stock packages to encourage long-term thinking.

## 2.5 Interacting with Investors, Intermediaries, and Other Market Participants

Investor relations are important to a company's overall corporate governance strategy. Effective communication that is straightforward, open, and free of potentially confusing corporate jargon has become a critical component of a company's image, overall message, and long-term success.

## 2.6 Companies in Domestic and Global Markets

Companies sometimes expand internationally, and there are advantages and disadvantages of such growth. International or global expansion efforts require careful and efficient communication, planning, and financing.

# Key Terms

**agency theory** a principle that is used to explain and resolve issues in the relationship between business principals and their agents, most commonly between shareholders (principals) and company executives (agents)

**agent** a person who acts on behalf of another person or group

**annual meeting** a meeting of the general membership and shareholders of a corporation; also known as an annual general meeting (AGM)

**annual report** a document describing a public corporation's operations and financial condition that must be provided to shareholders once per year; also known as Securities and Exchange Commission (SEC) Form 10-K

**articles of incorporation** a set of formal documents filed with a government body to legally document the creation of a corporation

**board of directors (BOD)** a group of people who jointly supervise the activities of an organization

**C corporation** a legal structure for a corporation in which the owners, or shareholders, are taxed separately from the entity

**close (closely held) corporation** a company that has only a limited number of shareholders

**conference call** a meeting or presentation conducted via telephone or internet to relay company information to all interested parties, including institutional and individual investors, as well as buy-and-sell side analysts; also known as an earnings conference call

**corporate governance** the system of rules, practices, and processes by which a firm is directed and controlled

**corporation** a legal entity that is separate and distinct from its owners

**domestic corporation (in state)** a corporation incorporated under the laws of the country or state in which it does business

**Electronic Data Gathering, Analysis, and Retrieval system (EDGAR)** the primary system for collecting and indexing documents submitted by companies and others under the Securities Act of 1933, the Securities Exchange Act of 1934, the Trust Indenture Act of 1939, and the Investment Company Act of 1940

**ESG** environmental, social, and governance (ESG) standards for a company's operations that socially conscious investors use to screen potential investments

**foreign corporation (out of state or out of country)** an existing corporation that conducts business in a state or jurisdiction other than where it was originally incorporated

**Generally Accepted Accounting Principles (GAAP)** a common set of accounting principles, standards, and procedures issued by the Financial Accounting Standards Board (FASB)

**global markets** economies or markets that are multinational in nature, spanning several different countries or jurisdictions

**hybrid form of business** a limited liability company (LLC) or limited liability partnership (LLP) that combines the characteristics of a corporation with those of a sole proprietorship or partnership

**International Financial Reporting Standards (IFRS)** accounting standards used by international corporations, issued by the IFRS Foundation and the International Accounting Standards Board

**investor** a person or an entity, such as a firm or mutual fund, that invests capital with the expectation of receiving financial returns

**investor relations (IR)** a strategic management responsibility that is capable of integrating finance, communication, marketing, and securities law compliance to enable the most effective two-way communication between a company and the financial community or other constituencies, which ultimately contributes to a company's securities achieving fair valuation

**limited liability corporation (LLC)** a US-specific form of a private limited company; a business structure that can combine the pass-through taxation of a partnership or sole proprietorship with the limited liability of a corporation

**limited liability partnership (LLP)** a partnership in which some or all partners have limited liabilities; can exhibit elements of both partnerships and corporations

**non-stock corporation** a corporation that does not have owners represented by shares of stock but typically has members who are the functional equivalent of stockholders in a stock corporation (having the right to vote, etc.); describes the vast majority of not-for-profit corporations

**nonprofit (not-for-profit) corporation** a legal entity that has been incorporated under the law of its jurisdiction for purposes other than making profits for its owners or shareholders

**partnership** a formal arrangement by two or more parties to manage and operate a business and share its profits and liabilities equally

**press release** an official statement delivered to members of the news media for the purpose of making an announcement or otherwise providing information

**principal** the person with the highest authority or most important position in a company, organization, institution, or group

**professional corporation** a form of corporate entity used by licensed professionals such as attorneys, architects, engineers, public accountants, and physicians, which is regulated by special provisions in many

corporation statutes

**public benefit corporation** a specific type of Delaware general corporation that is owned by shareholders who expect the company to make a profit and return some of that money to them in the form of dividends

**quarterly report** a document describing a public corporation's operations and financial condition that must be provided to shareholders four times per year; also known as Securities and Exchange Commission (SEC) Form 10-Q

**S corporation** a closely held corporation that makes a valid election to be taxed under Subchapter S of Chapter 1 of the Internal Revenue Code, which does not require such corporations to pay income taxes and instead taxes owners as individuals

**secretaries of state** the state officials who head the agencies responsible for, among other functions, the chartering of businesses (usually including partnerships and corporations) that wish to operate within their state and, in most states, for maintaining all records on business activities within the state; also known as secretaries of the commonwealth in Massachusetts, Pennsylvania, and Virginia

**Securities and Exchange Commission (SEC)** a large, independent agency of the United States federal government whose primary purpose is to enforce laws against market manipulation; created following the stock market crash of 1929 to protect investors and the national banking system

**shareholder (stockholder)** an individual or institution that legally owns one or more shares of the share capital of a public or private corporation; may be referred to as members of a corporation

**sole proprietor (and sole proprietorship)** a form of business that is operated and run by a single individual, known as the sole trader, with no legal distinction between the owner and the business entity

**stakeholder** a person with an interest or concern in a business

**stock corporation** a for-profit organization that issues shares of stock to shareholders (also known as stockholders) to raise capital, with each share representing partial ownership of the corporation and granting shareholders certain ownership rights to shape company policies

**subscriber** an initial shareholder of a company at the time of its incorporation whose name appears on the memorandum of association, a legal document prepared in the formation and registration process of a company to define its relationship with shareholders

## CFA Institute

This chapter supports some of the Learning Outcome Statements (LOS) in this CFA® Level I Study Session (https://openstax.org/r/cfa-institute-org). Reference with permission of CFA Institute.

## Multiple Choice

1. An S corporation _____.
   - **a.** is taxed in the same manner as a C corporation
   - **b.** is eligible for more efficient financing in the face of company growth than a C corporation
   - **c.** is usually more difficult to form than a C corporation
   - **d.** is not taxed at the corporate level, unlike a C corporation

2. An important advantage of a sole proprietorship is that _____.
   - **a.** it is easier to raise capital under such a structure than under other organizational forms
   - **b.** it allows for an unlimited life of the business
   - **c.** it is relatively easy to create
   - **d.** Both a and b are correct.

3. A shareholder is someone who _____.
   - **a.** sits on the audit committee of a firm
   - **b.** is an ex-employee of a company
   - **c.** profits from the favorable results of a company
   - **d.** follows the company for an investment firm

4. Effective corporate governance includes all of the following EXCEPT _____.
   a. fairness
   b. accountability
   c. objectivity
   d. higher share price

5. A stakeholder is someone who _____.
   a. is required to read a company's annual report
   b. answers to a board of directors
   c. has a vested interest in a company's success
   d. is hired to do a specific job

6. "An effective business leader will recognize the social and environmental responsibilities of their business as well as the eventual goal of achieving long-term, sustainable global development." This statement refers to _____.
   a. employing an experienced environmental consulting firm
   b. the advantages of having an audit committee
   c. having a diversified and well-experienced board of directors
   d. practicing strong corporate governance

7. An important component of a strong board of directors (BOD) is having members who are _____.
   a. former employees of the company
   b. able to write a strong corporate press release
   c. culturally diverse and experienced in the industry
   d. new to the industry and without preconceptions

8. Which of the following is NOT a reason why a company needs good corporate governance?
   a. to avoid mismanagement of the company
   b. to enable the company to raise capital more efficiently and mitigate financial and operational risk to stakeholders
   c. to analyze the company's operations and systems of internal control in order to detect and prevent various forms of fraud and other accounting irregularities
   d. to increase the company's overall accountability and prevent significant organizational problems

9. Who ultimately runs the company operations for a large corporation?
   a. shareholders
   b. board of directors
   c. external auditors
   d. stakeholders

10. One of the ways in which companies attempt to mitigate short-term managerial focus is by offering managers _____.
    a. increased vacation time
    b. increased paid sick leave
    c. stock options
    d. comprehensive health insurance

11. Which of the following are used to ensure fiduciary responsibility?
    a. audits
    b. press releases
    c. end-of-year financial ledgers
    d. a letter from the board of directors

12. Which of the following is NOT one of the roles of an audit committee?

**a.** reviewing the work of the internal audit
**b.** reviewing systems of internal control.
**c.** ensuring that appropriate resources are used in company operations
**d.** launching special investigations of employees, company practices, or procedures

**13**. Which of the following is a major issue addressed in corporate governance?
**a.** improving banking relations
**b.** ethics and its implementation
**c.** improving profits for shareholders
**d.** expanding operations internationally

**14**. Agency problems are essentially _____.
**a.** conflicts of interest
**b.** problems with the IRS
**c.** fraudulent business activities
**d.** nepotism

**15**. The term ESG, when used in the context of corporate governance, refers to which of the following?
**a.** earnings, shareholders, and governance
**b.** earnings, social, and general profit
**c.** environmental, social, and goals
**d.** environmental, social, and governance

**16**. Which of the following is the best method to ensure that shareholders are well informed of corporate policies and financial results?
**a.** self-evaluation and training for members of the board of directors
**b.** hiring a prestigious independent public accounting firm
**c.** ensuring cultural diversity and public speaking eloquence of the senior management team
**d.** conducting well-organized shareholder meetings and conference calls with the investment community

**17**. The Securities and Exchange Commission (SEC) requires that public corporations file which of the following financial reports on a quarterly basis?
**a.** Form 10-K
**b.** Form 8-Q
**c.** Form 10-Q
**d.** Form Q

**18**. Investor relations has substantially more _____.
**a.** regulatory obligations than standard public relations because of government-mandated financial and legal requirements
**b.** personnel within a company dedicated to its function compared to other corporate departments
**c.** interpretations regarding its effective implementation and use than other managerial and financial disciplines
**d.** documented historical cases of corporate failure than other managerial and financial disciplines

**19**. The corporate press release is _____.
**a.** no longer an important component of modern investor relations strategy
**b.** not yet a thing of the past, though it is highly likely to be replaced by social media in the near future
**c.** written by the chief financial officer in conjunction with the audit committee
**d.** best written to be easy to understand, free of corporate jargon, and as concise as possible

**20**. International firms are _____.
**a.** headquartered in a non-US country but have homogeneous profit centers with little differentiation in product or service

**b.** based in the United States but operate through the use of heavy investments outside the country via multinational profit centers
**c.** larger and more complex than their domestic counterparts
**d.** more likely to be formed as partnerships or sole proprietorships than as corporations

## Review Questions

1. What are the key differences between the potential life of a business that is formed as a sole proprietorship and that of a business set up as a corporation?
2. What are the most common types of firms that are organized as limited liability partnerships?
3. What advantages does a sole proprietorship offer?
4. What are major disadvantages of a sole proprietorship?
5. If a company wishes to limit the liability of some of its investing partners, what form of business might it consider? Explain briefly.
6. In order to form a corporation, what is the most important document required?
7. What is the difference between a shareholder and a stakeholder?
8. What group within a corporation has the primary responsibility for protecting the interests of shareholders?
9. What is corporate governance?
10. What role does a corporation's board of directors play in corporate governance?
11. Briefly explain the concept of corporate governance.
12. What is the key component of agency theory, and why might this be more important to a public company than to one that is privately held?

## Video Activity

### Corporate Governance (Introduction)

Access multimedia content (http://openstax.org/books/principles-finance/pages/2-video-activity)

1. 1. Describe the five key responsibilities of the board of directors of a company. Why are each of these responsibilities important to the operation of the organization as a whole?
   2. Discuss important related concepts, such as establishing corporate objectives, determining strategies to reach those objectives, providing leadership, supervising management of the business, and reporting to shareholders on the status and operations of the business.
   3. Discuss why these responsibilities of the board of directors may be more important for a public corporation than for a privately held company.

2. a. What are three essential best practices in corporate governance? Discuss important relevant concepts, such as separation of duties, the need for non-executive directors, the importance of board member independence from other executives, company operations, and financial ties, as well as the importance of a non-executive audit committee.
   b. Discuss why corporate governance is an ongoing process that must continuously be evaluated by a company even after separation of duties, independence, and audit committees have been established.

### The Basics of Corporate Governance

Access multimedia content (http://openstax.org/books/principles-finance/pages/2-video-activity)

3. What is meant by LEARR in the context of governance codes? Discuss the various components that are referred to in the LEARR acronym and why they are important to a company's continuing operations.
4. Discuss the role of corporate governance in attempting to minimize agency problems and ensuring that a company's directors and management act in the best interest of the shareholders.

3

# Economic Foundations: Money and Rates

**Figure 3.1** Every company is impacted by the global economy. (credit: "World Currency" by Kari/flickr, CC BY 2.0)

## Chapter Outline

**3.1** Microeconomics
**3.2** Macroeconomics
**3.3** Business Cycles and Economic Activity
**3.4** Interest Rates
**3.5** Foreign Exchange Rates
**3.6** Sources and Characteristics of Economic Data

## Why It Matters

American Airlines is one of the largest airlines in the world, flying to 350 destinations in 50 countries.[1] The managers of American Airlines are running a complex company. They have to be familiar with aeronautical science, they have to know the laws and regulations impacting commercial air travel, and they must keep abreast of global weather conditions. There is a lot to know about the airline industry itself.

However, operating a company such as American Airlines requires more than knowledge of the science and technology of the industry. American Airlines does not operate in a vacuum. Like every company, it is impacted by the economic environment in which it operates. American Airlines has to be familiar with how supply and demand will impact fuel costs and other expenses. It must also be familiar with macroeconomic trends. During periods of high unemployment, it may be difficult for the company to sell tickets to people wanting to travel to vacation getaways. During periods of low unemployment, American Airlines may find it difficult to hire quality workers at a wage rate it considers reasonable. Global economic conditions will also impact American Airlines; as the economies of Europe expand rapidly, the euro will increase in value and impact the cost of items that American Airlines purchases along its European routes.

In "Item 1A. Risk Factors," beginning on page 16 of the 2019 annual report for American Airlines (https://openstax.org/r/2019-annual-report-for-american-airlines), the company lists some of the ways that it is impacted by macroeconomic and microeconomic conditions and the risks that these conditions place on the

1 American Airlines. "American Airlines Group." AA.com. Accessed October 25, 2021. https://www.aa.com/i18n/customer-service/about-us/american-airlines-group.jsp

company. In this chapter, we explore some of the economic concepts that managers should use as part of their strategic plan.

# 3.1 Microeconomics

## Learning Outcomes

By the end of this section, you will be able to:

- Identify equilibrium price and quantity.
- Discuss how changes in demand will impact equilibrium price and quantity.
- Discuss how changes in supply will impact equilibrium price and quantity.

## Demand

Microeconomics focuses on the decisions and actions of individual agents, such as businesses or customers, within the economy. The interactions of the decisions that businesses and customers make will determine the price and quantity of a good or service that is sold in the marketplace. Financial managers need a strong foundation in **microeconomics**. This foundation helps them understand the market for the company's products and services, including pricing considerations. Microeconomics also helps managers understand the availability and prices of resources that are necessary for the company to create its products and services.

A successful business cannot just create and manufacture a product or provide a service; it must produce a product or service that customers will purchase. **Demand** refers to the quantity of a good or service that consumers are willing and able to purchase at various prices during a given time period, **ceteris paribus** (a Latin phrase meaning "all other things being equal").

Let's consider what the demand for pizza might look like. Suppose that at a price of $30 per pizza, no one will purchase a pizza, but if the price of a pizza is $25, 10 people might buy a pizza. If the price falls even lower, more pizzas will be purchased, as shown in Table 3.1.

| Price ($) | Quantity |
|---|---|
| 30 | 0 |
| 25 | 10 |
| 20 | 20 |
| 15 | 30 |
| 10 | 40 |
| 5 | 50 |

**Table 3.1 Demand Schedule for Pizza**

The information in Table 3.1 can be viewed in the form of a graph, as in Figure 3.2. Economists refer to the line in Figure 3.2 as a *demand curve*. When plotting a demand curve, price is placed on the vertical axis, and quantity is placed on the horizontal axis. Because more pizzas are bought at lower prices than at higher prices, this demand curve is downward sloping. This inverse relationship is referred to as the **law of demand**.

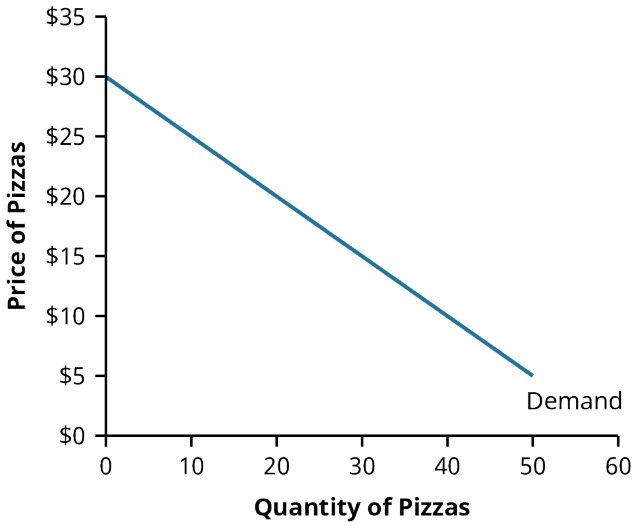


**Figure 3.2 Demand Curve for Pizzas**

The inverse relationship between the price of a good and the quantity of a good sold occurs for two reasons. First, as you consume more and more pizza, the amount of happiness that one more pizza will bring you diminishes. If you have had nothing to eat all day and you are hungry, you might be more willing to pay a high price for a pizza, and that pizza will bring you a great deal of satisfaction. However, after your hunger has been somewhat satisfied, you may not be willing to pay as much for a second pizza. You may only be willing to purchase a third pizza (to freeze at home) if you can get it at a fairly low price. Second, demand depends not only on your willingness to pay but also on your ability to pay. If you have limited income, then as the price of pizza rises, you simply cannot buy as much pizza.

The demand curve is drawn as a relationship between the price of the good and the quantity of the good purchased. It isolates the relationship between price and quantity demand. A demand curve is drawn assuming that no relevant factor besides the price of the product is changing. This assumption is, as mentioned above, ceteris paribus.

If another relevant economic factor changes, the demand curve can change. Relevant economic factors would include consumer income, the size of the population, the tastes and preferences of consumers, and the price of other goods. For example, if the price of hamburgers doubled, then families might substitute having a pizza night for having a hamburger cookout. This would cause the demand for pizzas to increase.

If the demand for pizzas increased, the quantities of pizza purchased at every price level would be higher. The demand schedule for pizzas might look like Table 3.2 after an increase in the price of hamburgers.

| Price ($) | Quantity |
|---|---|
| 30 | 9 |
| 25 | 19 |
| 20 | 29 |
| 15 | 39 |
| 10 | 49 |
| 5 | 59 |

**Table 3.2 Demand Schedule for Pizzas after the Price of Hamburgers Doubles**

This change leads to a movement in the demand curve—outward to the right, as shown in Figure 3.3. This is known as an increase in demand. Now, at a price of $25, people will purchase 19 pizzas instead of 10; and at a price of $15, people will purchase 39 pizzas instead of 30.

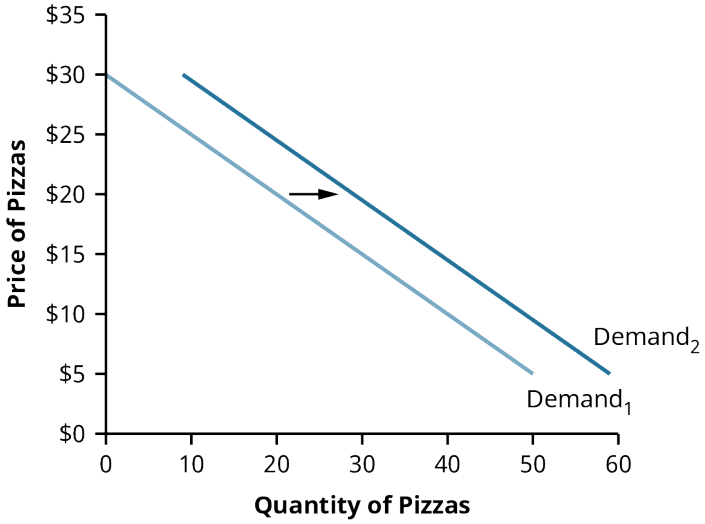


**Figure 3.3 An Increase in Demand Represented as a Movement of the Demand Curve to the Right**

A decrease in demand would cause the demand curve to move to the left. This could happen if people's tastes and preferences changed. If there were, for example, increased publicity about pizza being an unhealthy food choice, some individuals would choose healthier alternatives and consume less pizza.

LINK TO LEARNING

### Demand Curve Shifts

If any of the items that are assumed not to change when a demand curve is drawn do change, then the demand curve can shift. To learn more about these changes in demand, watch the MRU video on demand curve shifts (https://openstax.org/r/mru-video).

## Supply

**Supply** is the quantity of a good or service that firms are willing to sell at various prices, during a given time period, ceteris paribus. Table 3.3 is a fictional example of a supply schedule for pizzas. In some cases, higher prices encourage producers to provide more of their product for sale. Thus, there is a positive relationship between the price and quantity supplied.

| Price ($) | Quantity |
|---|---|
| 30 | 60 |
| 25 | 50 |
| 20 | 40 |
| 15 | 30 |
| 10 | 20 |
| 5 | 10 |

**Table 3.3 Supply Schedule for Pizzas**

The data from the supply schedule can be pictured in a graph, as is shown in Figure 3.4. Because a higher price encourages suppliers to sell more pizzas, the supply curve will be upward sloping.

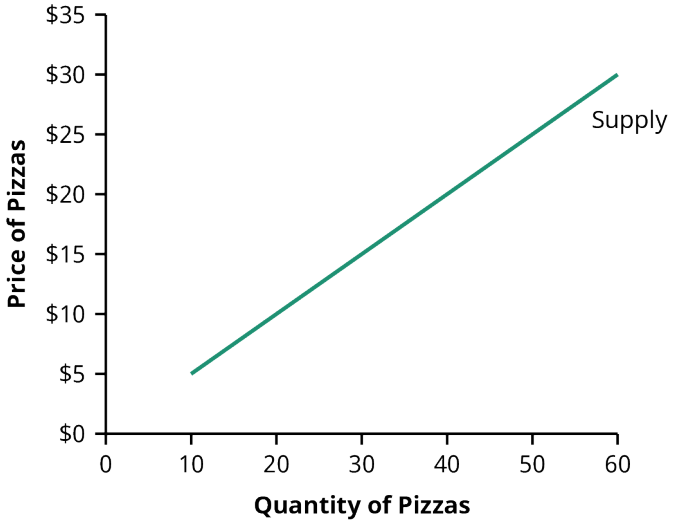


**Figure 3.4 Supply Curve for Pizzas**

The supply curve isolates the relationship between the price of pizzas and the quantity of pizzas supplied. All other relevant economic factors are assumed to remain unchanged when the curve is drawn. If a factor such as the cost of cheese or the salaries paid to workers changes, then the supply curve will move. A shift to the right indicates that a greater quantity of pizzas will be provided by firms at a particular price; this would indicate an increase in supply. A decrease in supply would be represented by a shift in the supply curve to the left.

LINK TO LEARNING

### Supply Curve Shifts

The ceteris paribus assumption is made when drawing a supply curve, just as it is when drawing a demand curve. If a relevant economic variable other than the price of the good for which the supply curve is drawn changes, the supply curve will shift. For more information about how changes in these variables will move the supply curve, watch the MRU video on supply curve shifts (https://openstax.org/r/mru-video-on-supply).

## Equilibrium Price

Demand represents buyers, and supply represents sellers. In the market, these two groups interact to determine the price of a good and the quantity of the good that is sold. Because both the demand curve and the supply curve are graphed with price on the vertical axis and quantity on the horizontal axis, these two curves can be placed in the same graph, as is shown in Figure 3.5.

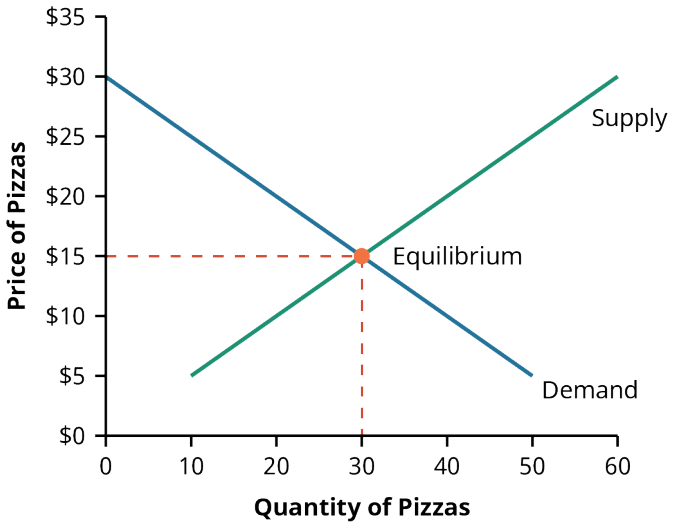


**Figure 3.5 Graph of Demand and Supply Showing Equilibrium Price and Quantity**

The point at which the supply and demand curves intersect is known as the **equilibrium**. At the **equilibrium price**, the quantity demanded will equal exactly the quantity supplied. There is no shortage or surplus of the product. In the example shown in Figure 3.5, when the price is $15, consumers want to purchase 30 pizzas and sellers want to make 30 pizzas available for purchase. The market is in balance.

A price higher than the equilibrium price will not be sustainable in a competitive marketplace. If the price of a pizza were $20, suppliers would make 40 pizzas available, but the quantity of pizzas demanded would be only 20 pizzas. This would be a surplus, or excess quantity supplied, of pizzas. Restaurant owners who see that they have 40 pizzas to sell but can only sell 20 of those pizzas will lower their prices to encourage more customers to purchase pizzas. At the same time, the restaurant owners will cut back on their pizza production. This process will drive the pizza price down from $20 toward the equilibrium price.

The opposite would occur if the price of a pizza were only $5. Customers may want to purchase 50 pizzas, but restaurants would only want to sell 10 pizzas at the low price. Quantity demanded would exceed quantity supplied. At a price below the equilibrium price, a shortage would occur. Shortages drive prices up toward the equilibrium price.

## LINK TO LEARNING

### The Equilibrium Price

A competitive market will drive prices to equilibrium. For a more in-depth understanding of this process, watch the MRU video on equilibrium price and quantity (https://openstax.org/r/mru-video-on-equilibrium).

## THINK IT THROUGH

### Graphing Demand and Supply

Consider the demand and supply schedules for sweatshirts shown below. Sketch a graph of demand and supply, placing quantity on the horizontal axis and price on the vertical axis. What will the equilibrium price for sweatshirts be? Table 3.4 provides the demand and supply schedules for the sweatshirts.

| Demand Schedule for Sweatshirts | | Supply Schedule for Sweatshirts | |
|---|---|---|---|
| Price ($) | Quantity | Price ($) | Quantity |
| 55 | 0 | 55 | 45 |
| 50 | 4 | 50 | 40 |
| 45 | 8 | 45 | 35 |
| 40 | 12 | 40 | 30 |
| 35 | 16 | 35 | 25 |
| 30 | 20 | 30 | 20 |
| 25 | 24 | 25 | 15 |
| 20 | 28 | 20 | 10 |
| 15 | 32 | 15 | 5 |
| 10 | 36 | 10 | 0 |
| 5 | 40 | | |

**Table 3.4 Demand and Supply Schedules for Sweatshirts**

**Solution:**

The demand curve for sweatshirts is the downward-sloping curve in Figure 3.6, showing the inverse relationship between price and quantity demanded. The upward-sloping curve is the supply curve for sweatshirts. The equilibrium price will be $30. At a price of $30, the quantity demanded of 20 sweatshirts equals the quantity supplied of 20 sweatshirts.

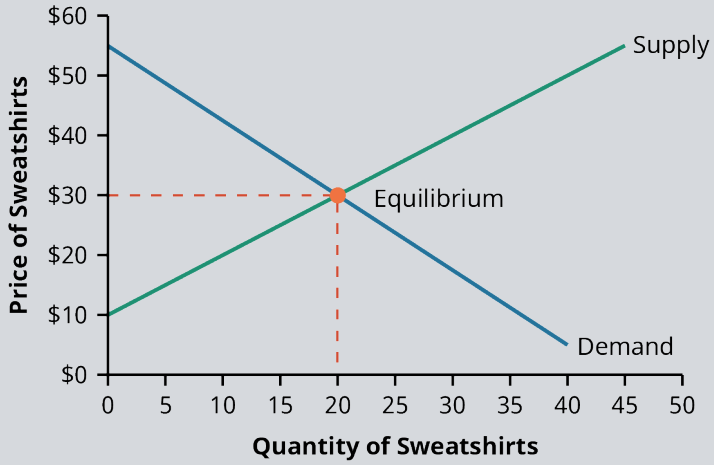


**Figure 3.6 Graph of Demand and Supply for Sweatshirts**

## Changes in Equilibrium Price

A price that is either too high (above the equilibrium price) or too low (below the equilibrium price) is not sustainable in a competitive market. Market forces pull prices to the equilibrium, where they stay until either supply or demand changes.

If supply increases and the curve moves outward to the right, as in Figure 3.7, then the equilibrium price will fall. With the original supply curve, $\text{Supply}_1$, the equilibrium price was $15; quantity demanded and quantity supplied were both 30 pizzas at that price. If a new pizza restaurant opens, increasing the supply of pizzas to $\text{Supply}_2$, the equilibrium will move from $\text{Equilibrium}_1$ $(E_1)$ to $\text{Equilibrium}_2$ $(E_2)$. The new equilibrium price will

be $10. This new equilibrium is associated with a quantity demanded of 40 pizzas and a quantity supplied of 40 pizzas.

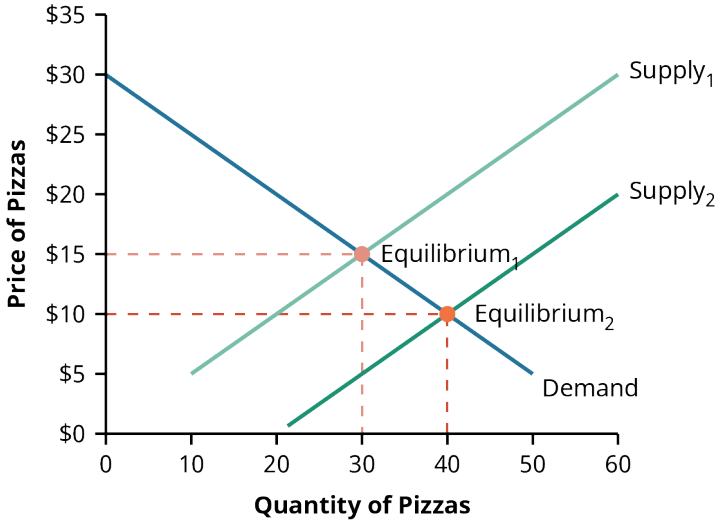


**Figure 3.7 Supply Curve Changes When Supply Increases** An increase in supply leads to a lower equilibrium price and an increase in quantity demanded.

It is important to note that the demand curve in Figure 3.7 does not move. In other words, demand does not change. As the equilibrium price falls, consumers move along the demand curve to a point with a combination of a lower price and a higher quantity. Economists call this movement an *increase in quantity demanded*. Distinguishing between an increase in quantity demanded (a movement along the demand curve) and an increase in demand (a shift in the demand curve) is critical when analyzing market equilibriums.

Equilibrium price will also fall if demand falls. Remember that a decrease in demand is represented as a shift of the demand curve inward to the left. In Figure 3.8, you can see how a decrease in demand causes a change from $E_1$ to $E_2$.

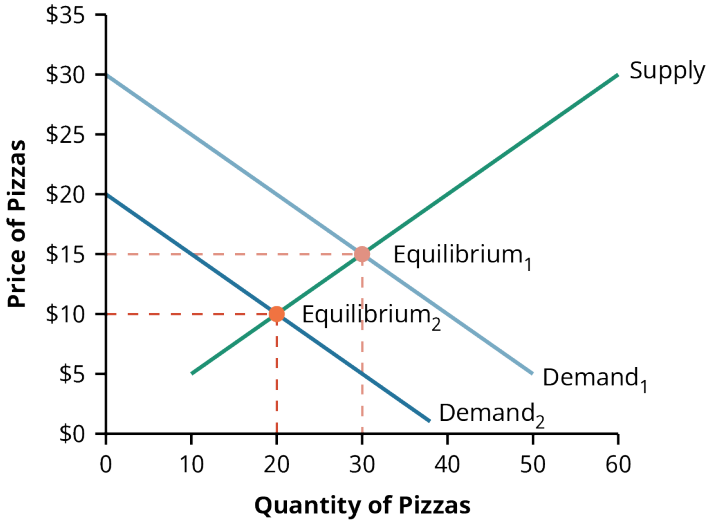


**Figure 3.8 A Decrease in Demand**

At the new equilibrium, $E_2$, the price of a pizza is $10. The new equilibrium quantity is 20 pizzas. Note that the supply curve has not moved. Producers moved along their supply curve, producing fewer pizzas as the price dropped; this is known as a *decrease in quantity supplied*.

## THINK IT THROUGH

### Graphing Demand

Suppose that the demand for sweatshirts in our previous example changes, and the demand schedule becomes the data shown in Table 3.5.

| Price ($) | Quantity |
|---|---|
| 55 | 18 |
| 50 | 22 |
| 45 | 26 |
| 40 | 30 |
| 35 | 34 |
| 30 | 38 |
| 25 | 42 |
| 20 | 46 |
| 15 | 50 |
| 10 | 54 |
| 5 | 58 |

**Table 3.5 Demand Schedule for Sweatshirts**

Has the demand for sweatshirts increased or decreased? Show this movement in a graph. What happens to the equilibrium? What are some reasons you can think of that may have caused this change in demand?

**Solution:**

This is an increase in demand. At every price, consumers now want to purchase more sweatshirts than they did before. This is shown in the graph as a movement of the demand curve outward to the right. Both the equilibrium price and the equilibrium quantity will rise because of this increase in demand. The equilibrium price will now be $40, and the equilibrium quantity of sweatshirts will be 30. Note that there is not an increase in supply; the supply curve does not move. There is simply an increase in quantity supplied (see Figure 3.9).

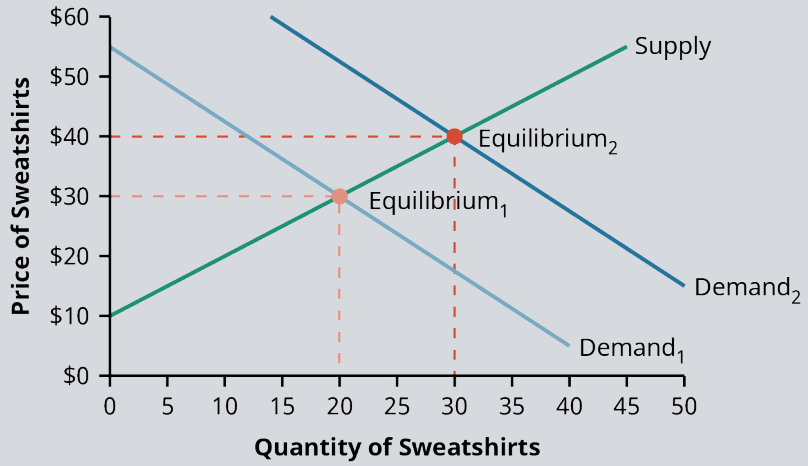


**Figure 3.9 Graph Showing Increase in Sweatshirt Supply**

A change in any of the factors that are assumed to be held constant under the ceteris paribus assumption could have caused the demand curve to shift to the right. Perhaps a rise in consumers' incomes led them to purchase more clothing, including sweatshirts. Or an unseasonably cool fall could result in more people purchasing sweatshirts. If a popular TV personality indicates that their favorite weekend wardrobe consists of jeans and a sweatshirt and the tabloids run pictures of the celebrity wearing sweatshirts, the tastes and preferences of consumers may change. Another possibility is that the price of sweaters may have risen, causing people to substitute sweatshirts for sweaters.

# 3.2 Macroeconomics

## Learning Outcomes

By the end of this section, you will be able to:

- Define inflation and describe historical trends in inflation.
- Define unemployment and describe how unemployment is measured.
- Define gross domestic product and describe historical trends in gross domestic product.

## Inflation

**Macroeconomics** looks at the economy as a whole. It focuses on broad issues such as inflation, unemployment, and growth of production. When the managers of an automotive company look at the market for steel and how the price of steel impacts the company's production costs, they are looking at a microeconomic issue. Rather than being concerned about individual markets or products, macroeconomics is the branch of economic theory that considers the overall environment in which businesses operate.

Perhaps you have heard your parents talk about how much they paid for their first automobile. Or maybe you have heard your grandparents reminisce about spending a quarter to purchase a Coke. These conversations often turn to a discussion of how a dollar just doesn't go as far as it used to. The reason for this is **inflation**, or a general increase in price levels.

It is not that just the price of an automobile has increased or that the price of a Coke has increased. Over time, the prices of many other things, from the salt on your table to college tuition, have increased. Also, you were paid a higher hourly wage at your first job than your parents and grandparents were paid; the price of labor has risen.

When economists talk about inflation, they are discussing this phenomenon of the price of many things rising. Instead of tracking the price of one particular item, they consider the price of purchasing a basket of goods.

Inflation means that the purchasing power of currency falls. Whenever there is inflation, a $100 bill will not purchase as much as it did before.

LINK TO LEARNING

CPI Inflation Calculator

According to the US Bureau of Labor Statistics, $100 in January 1913 had the same purchasing power as $1,722.45 in January 2000 and $2,699.20 in January 2021. If you would like to compare the purchasing power of a dollar amount in two different time periods, you can use the CPI Inflation Calculator (https://openstax.org/r/cpi-inflation-calculator). You can enter a current dollar amount and calculate its value in an earlier period. Alternatively, you can calculate the current value of dollar amounts from years ago.

## How Is Inflation Measured

Each month, the US Bureau of Labor Statistics (BLS) collects price data and publishes measures of inflation. The measure most commonly cited is the **consumer price index (CPI)**. The CPI is based on the cost of buying a fixed basket of goods and services comprising items a typical urban family of four might purchase. The BLS divides these purchases into eight major categories: food and beverages, housing, apparel, transportation, medical care, recreation, education and communication, and other goods and services.

Sometimes you will hear a **core inflation index** being quoted. This index is calculated by excluding volatile economic variables, such as energy and food prices, from the CPI measure. Energy and food prices can jump around from month to month because of weather or other short-lived events. A drought can cause food prices to spike; a temporary rise in gasoline prices can occur as a hurricane approaches the coastline. These types of shocks are transitory in nature and do not represent underlying economic conditions.

While the CPI and the core inflation index are based on the prices that households pay, the **producer price index (PPI)** is based on prices that producers of goods and services pay for their supplies and raw materials. The PPI captures price changes that occur prior to the retail level. Because it indicates rising costs to producers, increases in the PPI can foreshadow increases in the CPI.

Both the CPI and the PPI are calculated by the BLS. The Bureau of Economic Analysis (BEA) also calculates a measure of inflation known as the **GDP deflator**. The calculation of the GDP, or gross domestic product, deflator follows a different approach than that used to calculate the CPI and the PPI. Instead of using a fixed basket of items and measuring the price change of that fixed basket, the GDP deflator includes all of the components of the gross domestic product. Prices are taken from a base year and used to calculate what the GDP would have been in a given year if prices were identical to those in the base year.

LINK TO LEARNING

The Billion Prices Project

Although the concept of inflation as a rise in the general price level is simple, measuring and documenting this increase is complicated. The CPI is designed to measure the cost of a market basket of goods that a typical urban family purchases. But what the typical family purchases over time changes. As an item in the basket becomes more expensive, families tend to substitute and replace the item with similar goods. Also, the quality of goods changes over time. Think of how purchases in a typical household have changed over the last two decades. Today, few families purchase answering machines, CDs, DVDs, or alarm clocks; smartphones have replaced many such products. Smartphones are even used to make purchases for

delivery from an online retailer. Although keeping the items in the market basket constant allows economists to focus on price changes, the market basket quickly becomes outdated and does not reflect a typical family's purchases.

In an attempt to provide new measures of inflation that better represent the changing basket of goods purchased and the purchasing habits of families, Alberto Cavallo and Roberto Rigobon founded the Billion Prices Project. Through this academic initiative at the Massachusetts Institute of Technology, prices are collected daily from online retailers around the world. The Billion Prices Project website (https://openstax.org/r/billion-prices-project) provides measures for inflation using this data as well as research papers regarding macroeconomic research.

## Historical Trends in the Inflation Rate

Inflation, as measured by the CPI for 1947–2020, is displayed in Figure 3.10. The graph shows that for the past 70 years, inflation has been the norm. Although inflation dipped into negative territory several times, each period of negative inflation was short-lived. Also, you will notice that during the 1970s and early 1980s, inflation was abnormally high; the inflation rate remained above 5% for approximately a decade. This was also the only time period in which the US economy experienced double-digit inflation. By the mid-1980s, inflation had fallen below 5%, and it has remained below 5% for much of the past 35 years.

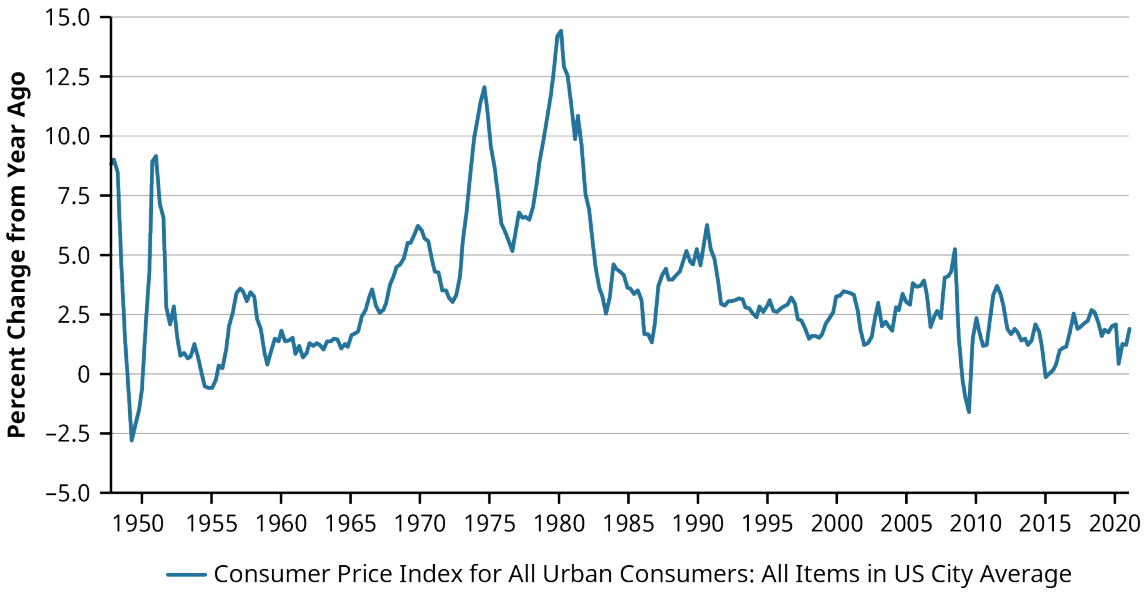


**Figure 3.10 Rate of Inflation Measured by the Consumer Price Index, 1947–2020**[2]

The Consumer Price Index for All Urban Consumers: All Items (CPIAUCSL) is a measure of the average monthly change in the price for goods and services paid by urban consumers between any two time periods. It can also represent the buying habits of urban consumers. This particular index includes roughly 88% of the total population, accounting for wage earners, clerical workers, technical workers, self-employed workers, short-term workers, unemployed workers, retirees, and those not in the labor force.

The CPIs are based on prices for food, clothing, shelter, fuels, transportation fares, service fees (e.g., water and sewer service), and sales taxes. Prices are collected monthly from about 4,000 housing units and approximately 26,000 retail establishments across 87 urban areas. To calculate the index, price changes are averaged with weights representing their importance in the spending of a particular group. The index measures price changes (as a percent change) from a predetermined reference date. In addition to the original unadjusted index distributed, the BLS also releases a seasonally adjusted index. The unadjusted series reflects all factors that may influence a change in prices. However, it can be very useful to look at the seasonally

adjusted CPI, which removes the effects of seasonal changes such as weather, the school year, production cycles, and holidays.

The CPI can be used to recognize periods of inflation and deflation. Significant increases in the CPI within a short time frame might indicate a period of inflation, and significant decreases in CPI within a short time frame might indicate a period of deflation. However, because the CPI includes volatile food and oil prices, it might not be a reliable measure of inflationary and deflationary periods. For more accurate detection, the core CPI, or CPILFESL (https://openstax.org/r/fred-stlouisfed-org)—the CPIAUCSL minus food and energy—is often used. When using the CPI, please note that it is not applicable to all consumers and should not be used to determine relative living costs. Additionally, the CPI is a statistical measure vulnerable to sampling error because it is based on a sample of prices and not the complete average.

## Unemployment

Unemployment is a measure of people who are not working. For the individuals who find themselves without a job, unemployment causes financial hardship. From a macroeconomics standpoint, unemployment means that society has labor resources that are not being fully utilized.

Not everyone who is without a job is **unemployed**. To be considered unemployed, a person must be (1) jobless, (2) actively seeking work, and (3) able to take a job. The official unemployment rate is the percentage of the labor force that is unemployed. It is calculated as

$$\begin{aligned} \text{Unemployment Rate} &= \frac{\text{Number Unemployed}}{\text{Labor Force}} \\ &= \frac{\text{Number Unemployed}}{\text{Number Employed} + \text{Number Unemployed}} \end{aligned} \tag{3.1}$$

Note that the unemployment rate is calculated as the percentage of the labor force that is unemployed, rather than the percent of the total population. Only those who are currently employed or who meet the definition of being unemployed are counted in the labor force. In other words, someone who is retired or a stay-at-home parent and is not seeking employment is not counted as unemployed and is not part of the labor force.

The Bureau of Labor Statistics (BLS) of the US Department of Labor reports the unemployment rate each month. These figures are attained through an interview process of 60,000 households conducted by the Census Bureau. (See Figure 3.11 for a graphic representation of historical trends in unemployment from 1950 to early 2021.)

2 Data from US Bureau of Labor Statistics. "Consumer Price Index for All Urban Consumers: All Items in US City Average (CPIAUCSL)." FRED. Federal Reserve Bank of St. Louis, accessed July 7, 2021. https://fred.stlouisfed.org/series/CPIAUCSL

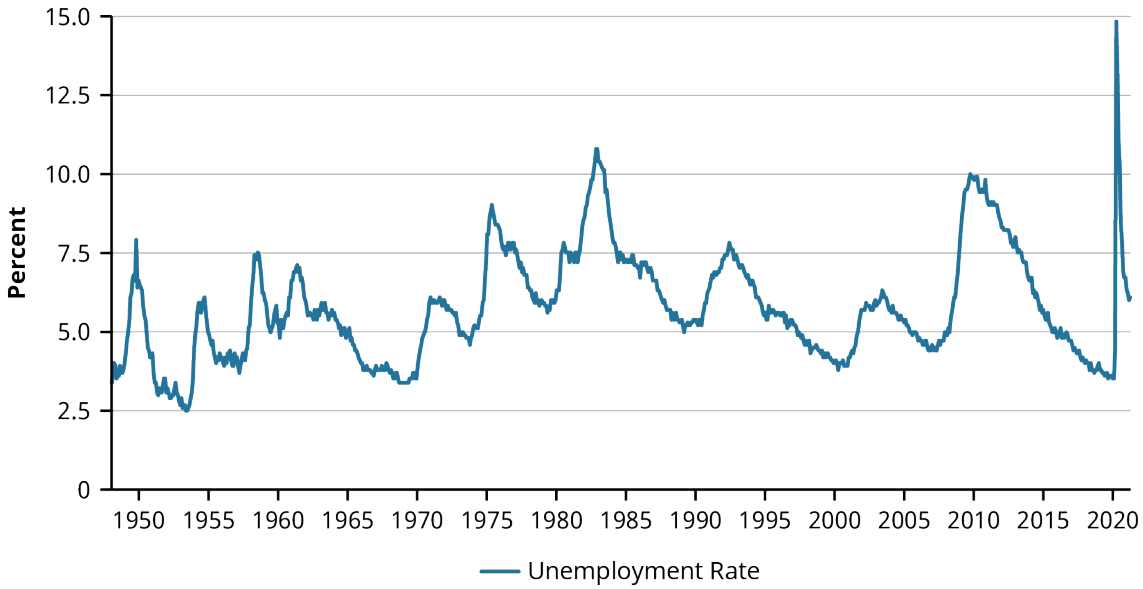


**Figure 3.11 Historical Trends in the Unemployment Rate by Year, 1950–2021**[3] The unemployment rate represents the number of unemployed as a percentage of the labor force. Labor force data are restricted to people 16 years of age and older who currently reside in one of the 50 US states or the District of Columbia, who do not reside in institutions (e.g., penal or mental facilities, homes for the aged), and who are not on active duty in the US Armed Forces.

LINK TO LEARNING

### Unemployment around the World

The World Bank publishes unemployment figures for countries around the world. In 2020, the World Bank figures showed that Cambodia had the lowest unemployment rate at 0.3% and that South Africa has the highest unemployment rate at 28.7%. To compare the rates in various countries, visit the unemployment statistics section (https://openstax.org/r/data-world-bank) of the World Bank website.

## Gross Domestic Product

**Gross domestic product (GDP)** is a measure of the size of an economy. A country's GDP is the dollar value of all of the final goods and service produced within that country during a year. GDP measures the value of all of the automobiles produced, apples grown, heart surgeries performed, students educated, and all other new goods and services produced in a current year.

### How Is GDP Measured?

GDP can be measured by adding up all of the items that are purchased in the economy. Purchases are divided into four broad expenditure categories: consumption spending, investment, government spending, and net exports. Consumption spending measures the items that households purchase, such as movie theater tickets, cups of coffee, and clothing. Consumption expenditure accounts for about two-thirds of the US GDP.[4]

Investment spending refers primarily to purchases by businesses. It is important to note that in this context, the term *investment* does not refer to purchasing stocks and bonds or trading financial securities. Instead, the term refers to purchasing new capital goods, such as buildings, machinery, and equipment, that will be used to produce other goods. Residential housing is also included in the investment-spending category, as are inventories. Products that producers make but do not sell this year (and so are not included in consumption

3 Data from US Bureau of Labor Statistics. "Unemployment Rate (UNRATE)." FRED. Federal Reserve Bank of St. Louis, accessed July 6, 2021. https://fred.stlouisfed.org/series/UNRATE

4 US Bureau of Economic Analysis. "GDP and the Economy: Advance Estimates for the First Quarter of 2020." Survey of Current Business 100, no. 5 (May 2020): 1–11. https://apps.bea.gov/scb/2020/05-may/0520-gdp-economy.htm

spending) are included in this year's GDP calculation through the investment component. The investment spending category is roughly 15% to 18% of the US GDP.

Government spending includes spending by federal, state, and local governments. Federal spending would include purchases of items such as a new military fighter jet and services such as the work of economists at the BLS. State governments purchase products such as concrete for a new highway and services such as the work of state troopers. Local governments purchase a variety of goods and services, such as books for the city library, playground equipment for the community park, and the services of public school teachers. In the United States, government spending accounts for nearly 20% of the GDP.

Some items that are produced in the United States are sold to individuals, businesses, or government entities outside of the United States. For example, a bottle of Tabasco sauce produced in Louisiana may be sold to a restaurant in Vietnam, or tires produced in Ohio may be sold to an auto producer in Mexico. Because these items represent production in the United States, these exports should be included in the US GDP. Conversely, some of the items that US consumers, businesses, and government entities purchase are not produced in the United States. A family may purchase maple syrup from Canada or a Samsung television that was produced in South Korea. A business may purchase a Toyota vehicle that was produced in Japan. These items are imported from other countries and represent production in the country of origin rather than the United States. Because we already counted these items when adding consumption, investment, and government spending, we must subtract the value of imports in our GDP calculation. Net exports equals exports from the United States minus imports from other countries. Including net exports in the GDP calculation adjusts for this international trade.

## Historical Trends in GDP

US GDP over the past 70 years is represented by the blue line in Figure 3.12. At the turn of the millennium, the yearly GDP of the United States was approximately $10 trillion. By 2020, the GDP exceeded $21 trillion, indicating that the US economy had more than doubled in size in the first 20 years of the 21st century.[5]

Because GDP is the market value of all goods and services produced, it can increase either because more goods and services are being produced or because the market value of these goods and services is rising. If 100 cars were produced and sold for $30,000 each, that would contribute $3,000,000 to the GDP. If, instead, the cars were sold for $33,000 each, the same 100-car production would contribute $3,300,000 to the GDP. The $300,000 increase in GDP would be due simply to higher prices, or inflation.

Multiplying the current price of goods by the number of goods produced results in what is known as nominal GDP. In order to determine what the actual increase in production is, nominal GDP must be adjusted for inflation. This adjustment results in a calculation known as real GDP. To calculate real GDP, the amounts of goods and services produced are multiplied by the price levels in a base year. Thus, real GDP will rise only if more goods and services are being produced. The red line in Figure 3.12 represents the real GDP. Although its growth has not been as large as that of nominal GDP, real GDP has also grown significantly over the past 70 years.

5 "GDP (Current US$): United States." The World Bank. 2020. https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=US

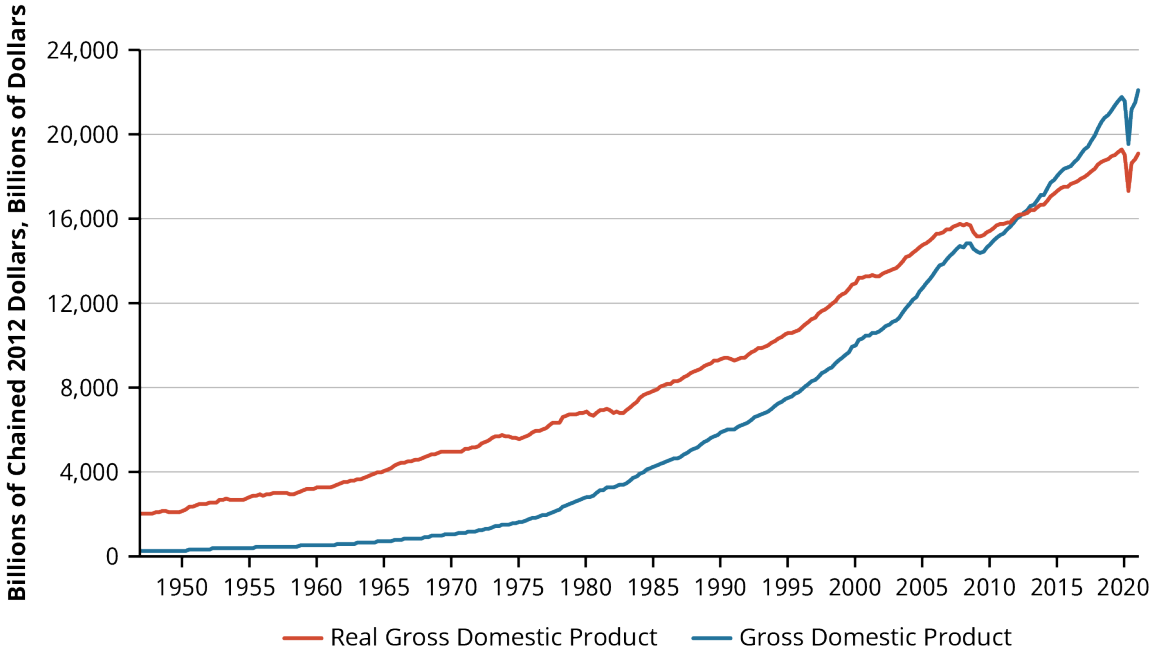


**Figure 3.12 Growth of the US GDP**[6] Gross domestic product (GDP), the featured measure of US output, is the market value of the goods and services produced by labor and property located in the United States. Real gross domestic product is the inflation-adjusted value of the goods and services produced by labor and property located in the United States. For more information, see the *NIPA Handbook: Concepts and Methods of the US National Income and Product Accounts* and the US Bureau of Economic Analysis.

LINK TO LEARNING

### US Bureau of Economic Analysis

The US Bureau of Economic Analysis, an agency of the Department of Commerce, produces economic accounting statistics, including GDP. The agency's economists and statisticians also produce measures of state and local economies, foreign trade statistics, and industry data. To learn more about the US Bureau of Economic Analysis and how it measures economic activity, visit the BEA website (https://openstax.org/r/bea-website). You can find data regarding the GDP and economic growth in your state, as well as international trade and industry statistics.

# 3.3 Business Cycles and Economic Activity

## Learning Outcomes

By the end of this section, you will be able to:

- Outline the stages of the business cycle.
- Identify recessionary and expansionary periods.

## What Is the Business Cycle?

Although the US economy has grown significantly over time, as seen in Figure 3.12, the growth has not occurred at a constant, consistent pace. At times, the economy has experienced faster-than-average growth, and occasionally the economy has experienced negative growth.

The percentage change in real GDP for each quarter is shown in Figure 3.13. For any quarter in which real GDP is growing, the percentage change will be positive. When the growth rate of real GDP is negative, the economy

6 Data from US Bureau of Economic Analysis. "Gross Domestic Product (GDP)." FRED. Federal Reserve Bank of St. Louis, accessed July 27, 2021. https://fred.stlouisfed.org/series/GDP

is shrinking.

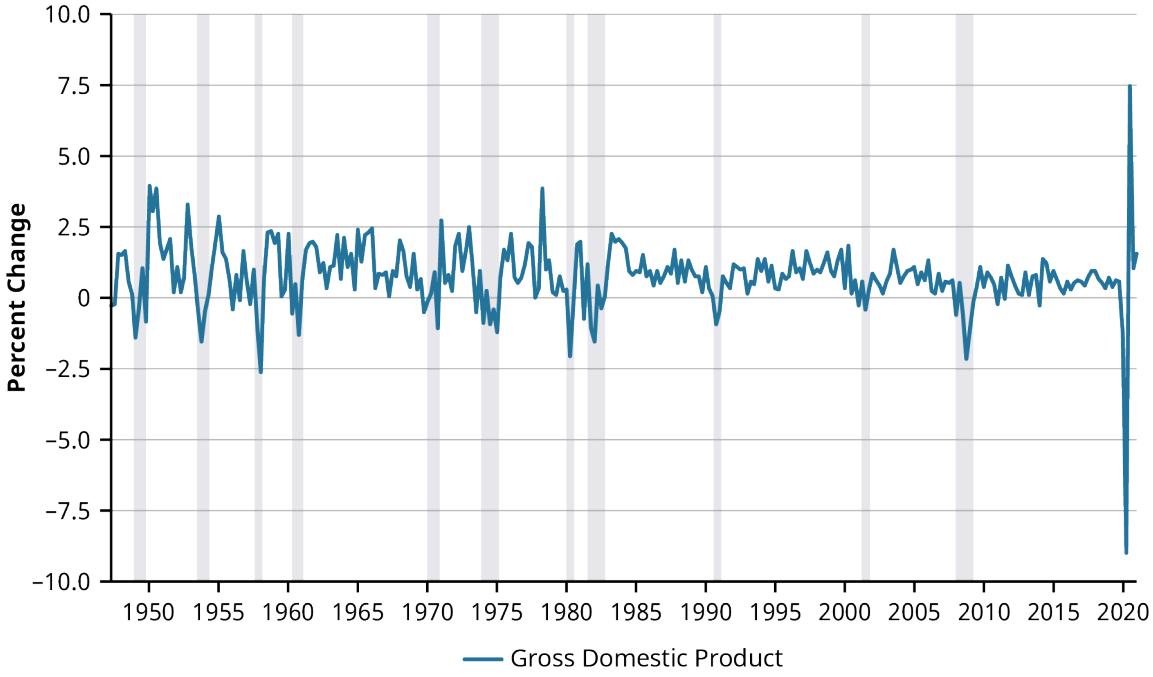


**Figure 3.13 Quarterly Percentage Change in US Real GDP with Shading Representing Recessions**[7]

Figure 3.14 is an illustration of the growth of GDP over time. There has been a definitive long-term upward trend in GDP, but it has not been in a straight line. Instead, the economy has expanded much like the curve; periods of quick growth are followed by slower or even negative growth. These alternating growth periods are known as the **business cycle**.

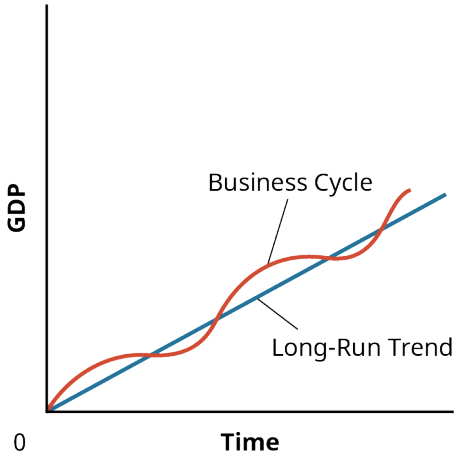


**Figure 3.14 Growth of GDP and the Business Cycle**

## Stages of the Business Cycle

The business cycle consists of a period of economic expansion followed by a period of economic contraction. During the period of economic **expansion**, GDP rises. Employment expands as businesses produce more; conversely, unemployment falls. Other measures of economic growth may include increased new business starts and new home construction. The economy is said to be "heating up." As the expansion continues, inflation often becomes a concern.

7 Data from US Bureau of Economic Analysis. "Gross Domestic Product (GDP)." FRED. Federal Reserve Bank of St. Louis, accessed July 7, 2021. https://fred.stlouisfed.org/series/GDP

Fast-paced economic expansion is not sustainable. Eventually, growth slows and unemployment rises. The economy has moved from expansion to contraction when this occurs. The point at which the business cycle turns from expansion to contraction is known as the *peak*. The point at which the contraction ends and the economy begins to expand again is known as the *trough*. The length of one business cycle is measured by the time from one trough to the trough of the next cycle, as shown in Figure 3.15.

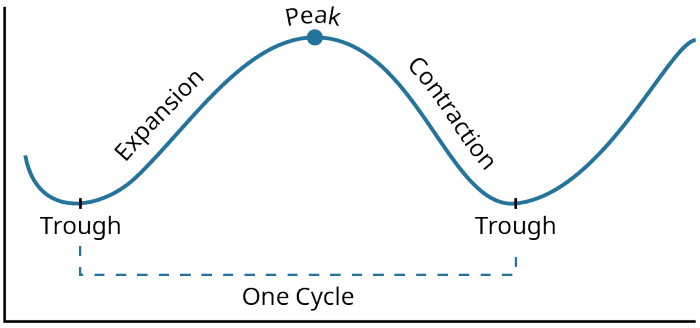


**Figure 3.15 Stages of the Business Cycle**

Often, the contraction is referred to as a **recession**. A private think tank, the National Bureau of Economic Research (NBER), tracks the business cycle in the United States. The NBER is the entity that officially declares recessions in the United States. Historically, a recession was defined as two consecutive quarters of declining GDP. Today, the NBER defines a recession in a broader, less precise manner; it will declare a recession when there is a significant decline in economic activity that is spread across the economy and lasts for at least a few months.[8] Measures of real income, employment, industrial production, and wholesale and retail sales are considered in addition to real GDP.

LINK TO LEARNING

### National Bureau of Economic Research

The National Bureau of Economic Research was founded in 1920 to create measures of economic activity that could be used in public policy discussions. It is a private, nonpartisan organization that conducts research that is followed by businesses and the public sector. You can find out more about the NBER and view many of its research papers by visiting its website (https://openstax.org/r/nber-website).

## Historical Trends

The NBER has identified business cycle peaks and troughs in data going back to the mid-19th century. Figure 3.16 lists each of these cycles, denoting the months of peaks and troughs. We see a repetition of the economic behavior—an expansion, a peak, a recession, and a trough, followed by yet another expansion, peak, recession, and trough. The cycles are events that repeatedly occur in the same order.

8 National Bureau of Economic Research. "Business Cycle Dating Committee Announcements." July 19, 2021. https://www.nber.org/research/business-cycle-dating/business-cycle-dating-committee-announcements

| Business Cycle Reference Dates | | | | Contraction | Expansion | |
|---|---|---|---|---|---|---|
| Peak Month | Peak Year | Trough Month | Trough Year | Peak to Trough (Months) | Previous Trough to This Peak (Months) | Trough from Previous Trough (Months) |
| - | - | December | 1854 | - | - | - |
| June | 1857 | December | 1858 | 18 | 30 | 48 |
| October | 1860 | June | 1861 | 8 | 22 | 30 |
| April | 1865 | December | 1867 | 32 | 46 | 78 |
| June | 1869 | December | 1870 | 18 | 18 | 36 |
| October | 1873 | March | 1879 | 65 | 34 | 99 |
| March | 1882 | May | 1885 | 38 | 36 | 74 |
| March | 1887 | April | 1888 | 13 | 22 | 35 |
| July | 1890 | May | 1891 | 10 | 27 | 37 |
| January | 1893 | June | 1894 | 17 | 20 | 37 |
| December | 1895 | June | 1897 | 18 | 18 | 36 |
| June | 1899 | December | 1900 | 18 | 24 | 42 |
| September | 1902 | August | 1904 | 23 | 21 | 44 |
| May | 1907 | June | 1908 | 13 | 33 | 46 |
| January | 1910 | January | 1912 | 24 | 19 | 43 |
| January | 1913 | December | 1914 | 23 | 12 | 35 |
| August | 1918 | March | 1919 | 7 | 44 | 51 |
| January | 1920 | July | 1921 | 18 | 10 | 28 |
| May | 1923 | July | 1924 | 14 | 22 | 36 |
| October | 1926 | November | 1927 | 13 | 27 | 40 |
| August | 1929 | March | 1933 | 43 | 21 | 64 |
| May | 1937 | June | 1938 | 13 | 50 | 63 |
| February | 1945 | October | 1945 | 8 | 80 | 88 |
| November | 1948 | October | 1949 | 11 | 37 | 48 |
| July | 1953 | May | 1954 | 10 | 45 | 55 |
| August | 1957 | April | 1958 | 8 | 39 | 47 |
| April | 1960 | February | 1961 | 10 | 24 | 34 |
| December | 1969 | November | 1970 | 11 | 106 | 117 |
| November | 1973 | March | 1975 | 16 | 36 | 52 |
| January | 1980 | July | 1980 | 6 | 58 | 64 |
| July | 1981 | November | 1982 | 16 | 12 | 28 |
| July | 1990 | March | 1991 | 8 | 92 | 100 |
| March | 2001 | November | 2001 | 8 | 120 | 128 |
| December | 2007 | June | 2009 | 18 | 73 | 91 |
| February | 2020 | - | - | - | 128 | - |

**Figure 3.16 Peak and Trough Months of Historical Business Cycles** (source: National Bureau of Economic Research)

However, the cycles are not identical; the lengths of the cycles vary greatly. On average, the contractions have lasted about 17 months and expansions have lasted about 41 months. The typical business cycle has been about 4.5 years long.

At the time of this writing, the United States is in an economic recession.[9] The previous trough was in June 2009. From the summer of 2009 through February 2020, the US economy was in the expansionary phase of the business cycle. This expansion peaked in February 2020, when the economy fell into a contractionary period associated with the COVID-19 pandemic. This 128-month expansion is the longest expansion in US history. Only two other expansions have lasted for over 100 months: the 120-month expansion that ran through the 1990s and the 106-month expansion that ran during the 1960s. The longest recessionary period on record is the 65-month recession that occurred during the 1870s. The recession that began in 1929 was the second-longest recession in US history. At 43 months long, this recession that ended in 1933 was so severe that it has been called the Great Depression.[10]

9 National Bureau of Economic Research. "Business Cycle Dating Committee Announcements." July 19, 2021. https://www.nber.org/research/business-cycle-dating/business-cycle-dating-committee-announcements

# 3.4 Interest Rates

## Learning Outcomes

By the end of this section, you will be able to:

- Explain the relationship between the nominal interest rate and inflation.
- Calculate the real rate of interest.
- Explain the relationship between interest rates and risk.

## Market for Loanable Funds

An interest rate is the rental price of money. The concepts of supply, demand, and equilibrium apply in this market just as they do in other markets. This market is referred to as the *market for loanable funds*.

In the market for loanable funds, the suppliers of funds are economic entities that currently have a surplus in their budget. In other words, they have more income than they currently want to spend; they would like to save some of their money and spend it in future time periods. Instead of just putting these savings in a box on a shelf for safekeeping until they want to spend it, they can let someone else borrow that money. In essence, they are renting that money to someone else, who pays a rental price called the *interest rate*.

The suppliers of loanable funds, also known as lenders, are represented by the upward-sloping curve in Figure 3.17. A higher interest rate will encourage these lenders to supply a larger quantity of loanable funds.

The demanders of funds in the loanable funds market are economic entities that currently have a deficit in their budget. They want to spend more than they currently have in income. For example, a grocery store chain that wants to expand into new cities and build new grocery stores will need to spend money on land and buildings. The cost of buying the land and buildings exceeds the chain's current income. In the long run, its business expansion will be profitable, and it can pay back the money that it has borrowed.

The downward-sloping curve in Figure 3.17 represents the demanders of loanable funds, also known as borrowers. Higher interest rates will be associated with lower quantities demanded of loanable funds. At lower interest rates, more borrowers will be interested in borrowing larger quantities of funds because the price of renting those funds will be cheaper.

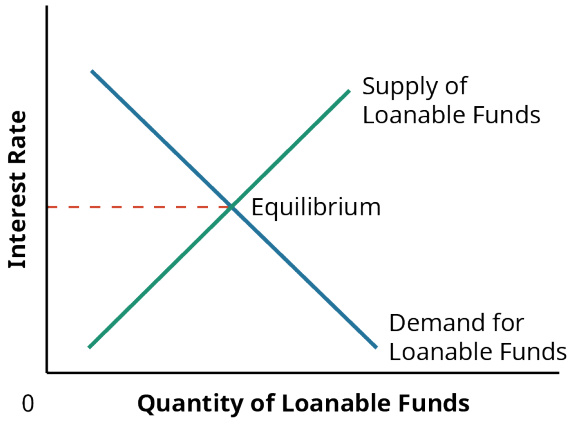


**Figure 3.17 Equilibrium in the Loanable Funds Market**

The equilibrium interest rate is determined by the intersection of the demand and supply curves. At that interest rate, the quantity supplied of loanable funds exactly equals the quantity demanded of loanable funds. There is no shortage of loanable funds, nor is there any surplus.

10 National Bureau of Economic Research. "US Business Cycle Expansions and Contractions." Last updated July 19, 2021. https://www.nber.org/research/data/us-business-cycle-expansions-and-contractions

## Nominal Interest Rates

The **nominal interest rate** is the stated, or quoted, interest rate. If you want to borrow money to purchase a car and the bank quotes an interest rate of 5.5% on a four-year auto loan, the 5.5% is the nominal interest rate.

Or suppose you have $1,000 you would like to place in a savings account. If the bank quotes an interest rate of 6% on its savings accounts, the 6% is a nominal interest rate. This means that if you place your $1,000 in a savings account for one year, you will receive $60 in interest for the year. At the end of the year, you will have a balance of $1,060 in your savings account—your original $1,000 plus the $60 in interest that you earned.

## Real Interest Rates

Suppose you are deciding between saving your $1,000 for the year and using it to purchase a flat-screen TV. The advantage of spending the money on the TV today is that you can enjoy watching programs on it over the next year. The advantage of saving the money is that you will earn 6% nominal interest; in one year, you will have $1,060 to spend.

If there is a 2% inflation rate, you would expect the TV that costs $1,000 today to cost $1,020 in one year. If you save the $1,000, you will have $1,060 in one year. You could purchase the TV for $1,020 and have $40 left over; then you could use the $40 to order pizza to celebrate the first big game you are watching on the new TV.

Your choice comes down to enjoying a TV today or enjoying a TV and $40 in one year. The $40 is your reward for delaying consumption. It is your real return for saving money. The remaining $20 of the interest you earned just covered the rate of inflation. This reward for delaying consumption is known as the **real interest rate**. The real interest rate is calculated as

$$\text{Real Interest Rate} = \text{Nominal Interest Rate} - \text{Inflation Rate} \tag{3.2}$$

The real interest rate, rather than the nominal interest rate, is the true determinant of the cost of borrowing and the reward for lending. For example, if a business had to pay 15% nominal interest rate in 1980, when the inflation rate was 12%, the real cost of borrowing for the firm was 3%. The company would have had to pay $15 in interest each year for each $100 it borrowed, but $12 of that was simply compensating the lender for inflation. In real terms, the business was only paying $3 to borrow $100.

In recent years, a business may have paid 6% interest to borrow money. This nominal rate is half of what it was in 1980. However, inflation has been much lower. If inflation is 1% and the company pays 6% nominal interest, that results in a 5% real interest rate. For every $100 the company borrows, it pays $6 in interest; $1 is compensating for inflation, and the remaining $5 is the real cost of borrowing.

## Risk Premiums

As we have discussed interest rates, we have talked about how the interest rate is determined by the demand and supply of loanable funds. This tells us the underlying interest rate in the economy. You will notice, however, if you look at the financial news, that there is more than one interest rate in the economy at any given time.

Figure 3.18 shows the interest rates that three different types of borrowers have paid over the past 20 years. The bottom line shows the interest rate that the US government paid to borrow money for a three-month period. This rate is often referred to as the risk-free rate of interest. While theoretically it would be possible for the US government to default and not pay back those people who have loaned money to it, the chances of that are occurring are extremely low.

When someone borrows money, they enter into a contract to repay the money and the interest owed. However, sometimes, certain circumstances arise such that the lender has a difficult time collecting the money, even though the lender has the legal right to the money. For example, if a company goes bankrupt after borrowing the money and before paying back the loan, the lender may not be able to collect what is due. The chance that the lender may not be able to collect all of the money due at the time it is due is considered *credit*

*risk*. Lenders want to be rewarded for taking on this risk, so they charge a premium to borrowers who are higher risk.

Companies are more likely to go bankrupt and not be able to pay their bills on time than the US government. So, corporations have to pay a higher interest rate than the US government. If a lender can earn 1% lending to the US government, the lender will only be willing to lend to the riskier corporation if they can earn more than 1%. In Figure 3.18, the interest rates paid by very creditworthy companies is shown. The prime rate is the interest rate that banks charge their very best customers—large companies that are financially very strong and have a very low risk of default.

It is generally riskier for a lender to make a loan to an individual than to a corporation. Individuals are more likely to become ill, lose their job, or experience some other financial setback that makes it difficult for them to repay their loans. In Figure 3.18, the interest rate on credit card loans is much higher than the interest rate charged to corporate borrowers. That is because credit card loans are a high risk to the lender. Unlike other loans made to an individual, such as a car loan, the credit card company has no collateral if a consumer cannot pay back the loan. With car loans, if the borrower fails to repay the borrowed money, the lender can repossess the automobile and sell it to recoup some of the money it is owed. If you use a credit card to buy groceries and do not repay the loan, the credit card company cannot repossess the groceries that you purchased. Therefore, credit card loans have notoriously high interest rates to compensate the lender for the high risk.

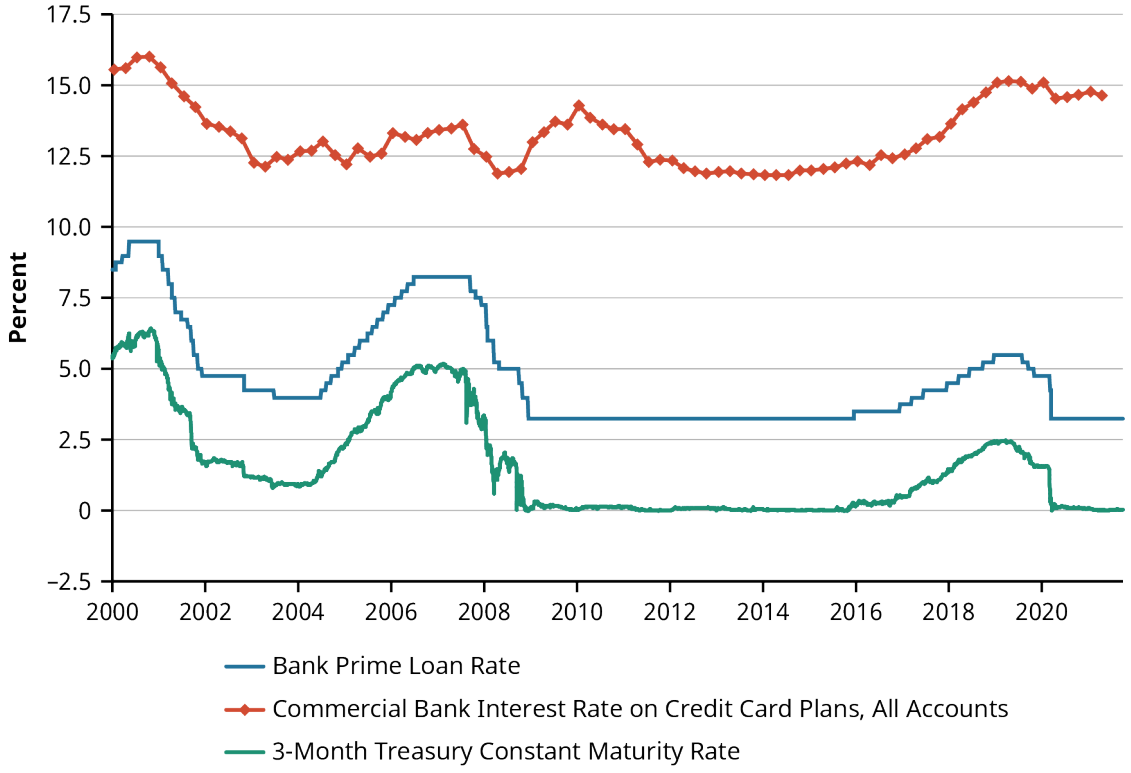


**Figure 3.18 Interest Rate on US Treasury Bills and Credit Cards**[11] This graph shows the rates posted by a majority of top 25 (by assets in domestic offices) insured US-chartered commercial banks. The prime rate is one of several base rates used by banks to price short-term business loans. For further information regarding Treasury constant maturity data, please refer to the Board of Governors and the Treasury.

11 Data from Board of Governors of the Federal Reserve System (US). "Bank Prime Loan Rate (DPRIME)." FRED. Federal Reserve Bank of St. Louis, accessed July 8, 2021. https://fred.stlouisfed.org/series/DPRIME; Board of Governors of the Federal Reserve System (US). "3-Month Treasury Constant Maturity Rate (DGS3MO)." FRED. Federal Reserve Bank of St. Louis, accessed July 8, 2021. https://fred.stlouisfed.org/series/DGS3MO; Board of Governors of the Federal Reserve System (US). "Commercial Bank Interest Rate on Credit Card Plans, All Accounts (TERMCBCCALLNS)." FRED. Federal Reserve Bank of St. Louis, accessed July 8, 2021. https://fred.stlouisfed.org/series/TERMCBCCALLNS

# 3.5 Foreign Exchange Rates

## Learning Outcomes

By the end of this section, you will be able to:

- Explain what it means for a currency to appreciate or depreciate.
- Define spot exchange rate.
- Explain the risks involved in translation exposure.

## Spot Exchange Rate

An exchange rate is simply the price of a currency. If you live in the United States and are going on a trip to Mexico, you will need pesos to pay for your food, hotel, and other items. You will need to purchase pesos. Suppose that you go to your bank to purchase pesos. Suppose the bank tells you that it will cost $0.0625 to purchase one Mexican peso. If you want to take 10,000 Mexican pesos with you on your trip, it will cost you $625 to purchase the desired pesos.

In this example, the price of one peso is six and one-quarter cents. This price will often be written in the form of

$$\text{MXN}\,1 = \text{USD}\,0.0625 \tag{3.3}$$

MXN is an abbreviation for the Mexican peso, and USD is an abbreviation for the US dollar. This price is known as a currency exchange rate, or the rate at which you can exchange one currency for another currency. Because this is the price you would pay to purchase Mexican pesos right now, it is known as the **spot exchange rate**.

If you know the price of Mexican pesos in dollars, you can easily find the price of US dollars in Mexican pesos. Simply divide both sides of the equation by 0.0625, or the price of a peso:

$$\text{MXN}\,1 = \text{USD}\,0.0625 \tag{3.4}$$

$$\frac{\text{MXN}\,1}{0.0625} = \frac{\text{USD}\,0.0625}{0.0625} \tag{3.5}$$

$$\text{MXN}\,16 = \text{USD}\,1 \tag{3.6}$$

If you have Mexican pesos and you want to exchange them for dollars, you will be using the pesos to buy dollars. Each US dollar will cost you MXN 16.

LINK TO LEARNING

### Currency Conversion

Do you want to know how many British pounds your $100 would buy? Or would you like to see how much that 10,000-yen-per-night hotel room will cost you in your home currency? You can enter the amount of one currency in the MSN Money currency converter (https://openstax.org/r/currencyconverter) to see what the equivalent amount is in another currency.

## Currency Appreciation

Just as the price of gasoline changes, resulting in it costing more to purchase gasoline on some visits to the gas station than on other visits, the price of a currency also changes. Currency appreciation occurs when it costs more to purchase a currency than it did before.

If the next time you go to the bank to purchase pesos, the bank quotes an exchange rate of $\text{MXN}\,1 = \text{USD}\,0.0800$, it means that it now costs $0.0800 (up from $0.0625) to purchase a Mexican peso. Hence, the price of a peso has risen, or the peso has appreciated.

Currency prices are determined in the marketplace through the same types of supply-and-demand forces we discussed earlier in this chapter. What would cause the peso to appreciate? Either an increase in the demand for pesos or a decrease in the supply of pesos.

## Currency Depreciation

Just as a currency can appreciate, it can depreciate. If the quote at the bank was $\text{MXN}\,1 = \text{USD}\,0.0500$, it would only cost $0.0500 to purchase a Mexican peso. When it costs fewer dollars to purchase a peso, the peso has depreciated. Either a decrease in demand for pesos or an increase in supply of pesos will cause the peso to depreciate.

Because an exchange rate is the price of one currency expressed in terms of another currency, if one of the currencies depreciates, the other currency must, by definition, appreciate. If it costs $0.0500 to purchase a Mexican peso, the price of a US dollar, in terms of a Mexican peso would be calculated as

$$\text{MXN}\,1 = \text{USD}\,0.0500 \tag{3.7}$$

$$\frac{\text{MXN}\,1}{0.0500} = \frac{\text{USD}\,0.0500}{0.0500} \tag{3.8}$$

$$\text{MXN}\,20 = \text{USD}\,1 \tag{3.9}$$

So, the price of one US dollar would be 20 Mexican pesos.

## Exchange Rate Risk

Businesses that engage in international business face currency exchange rate risk. As exchange rates change, a business can be impacted in a number of ways. One of these risks, **transaction exposure**, is the risk that the value of a business's expected receipts or expenses will change as a result of a change in currency exchange rates. A pottery-making business that has sold merchandise to a company in the United States for $20,000, for example, will need to exchange the $20,000 for pesos to be able to pay its workers and other expenses in pesos. How many pesos it will receive for $20,000 will change depending on the exchange rate. If the exchange rate is $\text{MXN}\,16 = \text{USD}\,1$, the company will receive 320,000 pesos for the $20,000. If the exchange rate is $\text{MXN}\,20 = \text{USD}\,1$, the company will receive 400,000 pesos for the $20,000. Thus, as the peso depreciates (and the US dollar appreciates), the same number of dollars will provide more pesos. Conversely, as the peso appreciates (and the US dollar depreciates), the same number of dollars will provide fewer pesos.

Firms that hold assets in a foreign country also face **translation exposure**. When a company creates its financial statements, items are reported using one currency. As foreign exchange rates change, the value of how items are reported on these financial statements can change. This type of risk is an accounting risk.

**Economic exposure** is the risk that a change in exchange rates will impact a business's number of customers and sales. For example, tourists have the option of spending a week-long vacation at a resort in the United States or in Mexico. As the dollar appreciates, US citizens can exchange their dollars for more pesos, resulting in their purchasing power going further at a Mexican resort. Because an appreciating dollar also means a depreciating peso, it would mean that Mexicans who earn pesos will receive fewer dollars when they exchange their pesos. A Mexican who wants to stay at a $200-per-night hotel in Colorado will need more pesos to pay for the room when the peso depreciates. The depreciating peso will likely mean that more Mexicans will spend their vacation week in Mexico, and fewer will vacation in the United States.

Even businesses that do not view themselves as involved in international business can face economic exposure. The ski lodge in Colorado will find that its customers from Mexico decrease when the dollar appreciates. Likewise, when the dollar appreciates, some of the ski lodge's US-based customers may choose instead to visit a resort in Mexico, where their purchasing power is strong.

# 3.6 Sources and Characteristics of Economic Data

## Learning Outcomes

By the end of this section, you will be able to:

- Interpret economic data.
- Compute the percent change for economic variables.

## FRED: Federal Reserve Economic Data

One of the largest sources of economic data is the Federal Reserve Economic Data (FRED) database.[12] This database is maintained by the Federal Reserve Bank of St. Louis and contains more than 765,000 economic time series. These time series are compiled by the Federal Reserve and come from a number of sources, including the Bureau of Labor Statistics and the US Census.

### LINK TO LEARNING

#### FRED

Data included in the FRED database is divided into these broad categories:

- Money, Banking, and Finance
- Population, Employment, and Labor Markets
- National Accounts
- Production and Business Activity
- Prices
- International Data
- US Regional Data
- Academic Data

Watch this FRED introduction video (https://openstax.org/r/what-is-fred) to learn more information about how to use FRED.

You can find statistics on employment, inflation, exchange rates, gross domestic product, interest rates, and many other economic variables in the FRED database. Although much of the data is about the US markets, macroeconomic data from other countries is also available. In addition to being viewable in graphical and text form on the FRED site, the data is easily downloaded into an Excel spreadsheet for analysis.

### LINK TO LEARNING

#### Creating a Stacked Area Graph

Not only does FRED provide an excellent source for economic data, but it allows users to create custom graphs that can be used in presentations and reports. To learn more about how to create these graphs, read this article on using stacking (https://openstax.org/r/fred-gdp-stacking). This tutorial provides step-by-step instructions for creating a stacked area graph of real GDP and its separate components and a real GDP area graph showing the percent that each of these components contributes to the total value of real GDP.

## Levels versus Percentage Changes

The same information can be presented in graphs several different ways. The particular format you choose will

12 Federal Reserve Bank of St. Louis. Economic Resources & Data. Accessed October 25, 2021. https://www.stlouisfed.org/

depend on how you are using the data.

Figure 3.19 shows the real GDP of Japan for 2010–2020. This chart is created showing the level of real GDP. The steep drop in 2020 highlights the economic decline associated with the COVID-19 pandemic. Looking at the chart, it is easy to see that after 10 years of a general upward trend, Japan's GDP quickly fell to a level not seen in the previous decade as COVID-19 began spreading in early 2020.

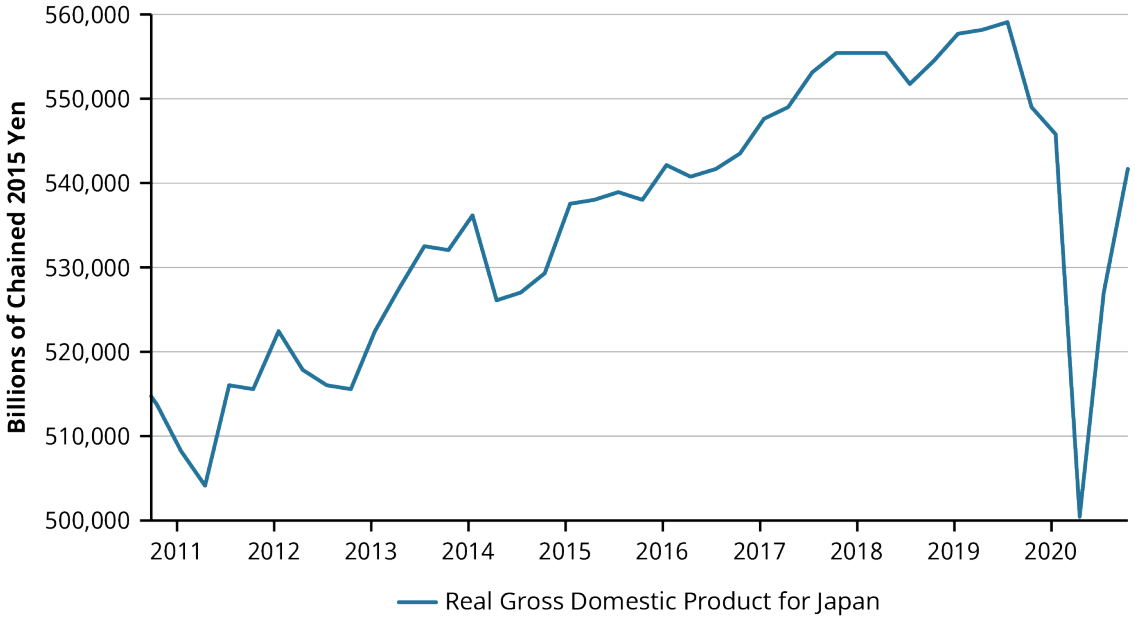


**Figure 3.19 Real Gross Domestic Product for Japan, 2010–2020**[13]

The vertical axis in Figure 3.19 is measured in yen. Over the time period shown, the real GDP ranged from 500 trillion yen to 560 trillion yen. The general trend (until COVID-19) was upward, indicating growth in the Japanese economy. However, the growth was not consistent from year to year.

Figure 3.20 also contains information about Japanese real GDP from 2010 to 2020. This chart measures the percent change for each quarter on the vertical axis. It is created using the same underlying data as Figure 3.19. Figure 3.20 demonstrates a way of highlighting the growth (or contraction) of an economy at a particular point in time.

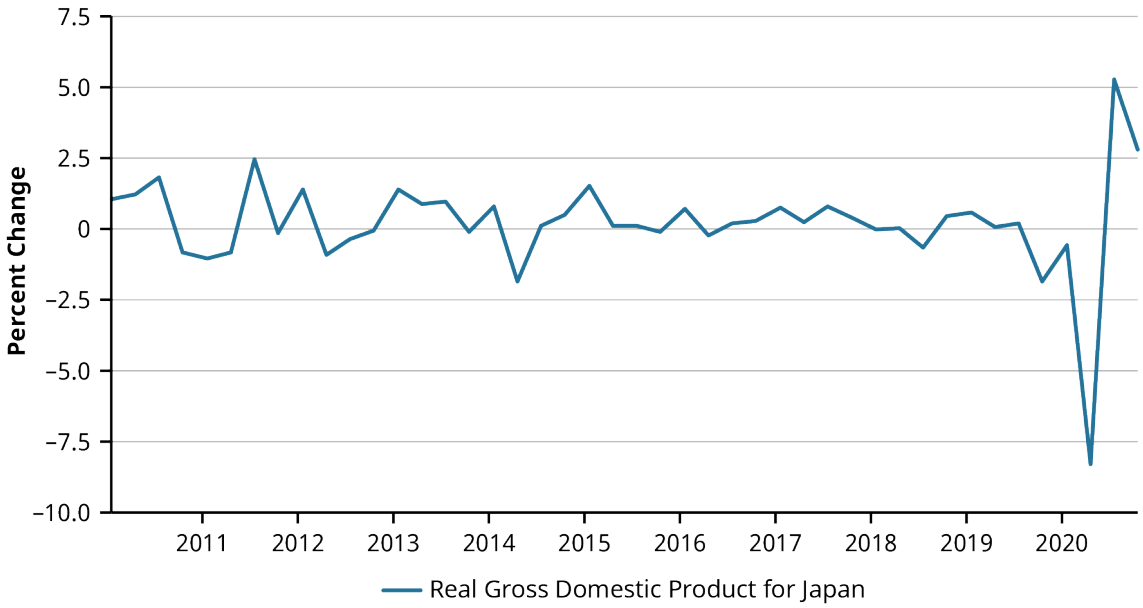


**Figure 3.20 Percent Change for Gross Domestic Product for Japan, 2010–2020**[14]

The formula to calculate the percentage change from one quarter to the next is

$$\text{Percentage Change} = \frac{\text{Quarter}_2 - \text{Quarter}_1}{\text{Quarter}_1} \quad \textbf{3.10}$$

In the first quarter of 2013, the real GDP for Japan was 522,594.2 billion yen. In the second quarter of 2013, the real GDP had risen to 527,277.0 billion yen. Thus, the percentage change in real GDP from quarter one to quarter two was

$$\text{Percentage Change} = \frac{\text{Quarter}_2 - \text{Quarter}_1}{\text{Quarter}_1} = \frac{527{,}277.0 - 522{,}594.2}{522{,}594.2} = 0.00896 = 0.896\% \quad \textbf{3.11}$$

As long as the percentage change for a quarter is positive, the real GDP in Figure 3.20 will rise; this indicates that the economy is growing. If the percentage change shown in Figure 3.20 is negative, then real GDP will fall; this indicates that the economy is contracting. Looking at the percentage change in Figure 3.20 is helpful for detecting when the economy is growing but the growth is slowing. If the percentage change is positive but lower than it was for the previous quarter, then GDP is growing, but the growth rate is slowing.

## Indexes

An index is created to track the performance of a particular aspect of the economy or the financial markets. An index helps compare the level of a variable at one point in time relative to another point in time. Indexes are often used when movement over time is more important than the absolute level of the variable at any one point in time.

Earlier in this chapter, we looked at the rate of change in the CPI to measure the rate of inflation. In its raw form, the CPI is an index. Remember that the CPI is a measure of the cost of a market basket of goods. When the index is created, the total cost of the market basket, whether it is $300 or $950, is irrelevant. What economists are interested in is the magnitude of the difference in cost of the same market basket at a later date.

In order to focus on the change over time, a base year is identified. The cost of the market basket in the base

13 Data from JP, Cabinet Office. "Real Gross Domestic Product for Japan (JPNRGDPEXP)." FRED. Federal Reserve Bank of St. Louis, accessed July 7, 2021. https://fred.stlouisfed.org/series/JPNRGDPEXP
14 Data from JP, Cabinet Office. "Real Gross Domestic Product for Japan (JPNRGDPEXP)." FRED. Federal Reserve Bank of St. Louis, accessed July 7, 2021. https://fred.stlouisfed.org/series/JPNRGDPEXP

year is given an index level of 100. Let's assume that the market basket costs $300 in the base year. If the same basket of goods costs $330 the following year, then the index level the following year would be 110. The index level increases by 10% when the cost of the market basket increases by 10%. This makes it easy to compare different measures of inflation.

For example, suppose a market basket costs 40,000 yen in the first year and 42,000 yen in the second year. In the base year, the CPI in Japan would be set at 100; the following year, the index would rise to 105 (because of the 5% rise in the market basket cost). Comparing the levels of the index in Japan with the index in the United States allows you to compare inflation trends in the two countries.

Table 3.6 contains the CPI for the United States, Japan, and Switzerland for each decade since 1970. A base year of 1970 is used for all three countries, so the index level is 100 for all three countries in 1970. You can see that Japan has experienced virtually no inflation for the last several decades. If the index level remains the same from one year to the next, there is a zero rate of inflation. Negative rates of inflation, or deflation, would be associated with a falling index level.

| Year | United States | Switzerland | Japan |
|---|---|---|---|
| 1970 | 100.0 | 100.0 | 100.0 |
| 1980 | 212.3 | 162.3 | 232.5 |
| 1990 | 336.5 | 226.4 | 291.2 |
| 2000 | 443.5 | 278.2 | 322.1 |
| 2010 | 561.6 | 304.3 | 313.6 |
| 2020 | 666.6 | 302.3 | 331.8 |

**Table 3.6 CPI Levels for the United States, Switzerland, and Japan**[15]

Using an index level helps us compare the impact that inflation has had on the cost of living in the three countries. Prices were rising rapidly in Japan in the 1970s, outpacing price increases in both the United States and Switzerland. By the mid-1980s, however, price increases in Japan tapered off. Although prices in Switzerland rose much more slowly in the 1970s, the price level continued to rise over the next couple of decades. Even though the price increases have followed different patterns in Switzerland and Japan, the overall price level today is about three times what it was in 1970 in both of those countries. However, the price level in the United States has continued to rise; today, the price level in the United States is about seven times higher than it was in in the 1970s.

15 Data from US Bureau of Labor Statistics. "Consumer Price Index for All Urban Consumers: All Items in US City Average (CPIAUCNS)." FRED. Federal Reserve Bank of St. Louis, accessed July 31, 2021. https://fred.stlouisfed.org/series/CPIAUCNS; Organization for Economic Co-operation and Development. "Consumer Price Index: All Items for Switzerland (CHECPIALLMINMEI)." FRED. Federal Reserve Bank of St. Louis, accessed July 31, 2021. https://fred.stlouisfed.org/series/CHECPIALLMINMEI; Organization for Economic Co-operation and Development. "Consumer Price Index of All Items in Japan (JPNCPIALLMINMEI)." FRED. Federal Reserve Bank of St. Louis, accessed July 31, 2021. https://fred.stlouisfed.org/series/JPNCPIALLMINMEI

# Summary

## 3.1 Microeconomics

Microeconomics is the study of individual economic decision makers. In the marketplace, buyers and sellers come together. The buyers are represented by a downward-sloping demand curve; lower prices are associated with a larger quantity demanded. The sellers are represented by an upward-sloping supply curve; higher prices are associated with a large quantity supplied. The point of intersection of the supply and demand curves determines the equilibrium price and quantity.

## 3.2 Macroeconomics

Macroeconomics looks at the economy as a whole. It focuses on broad issues such as inflation, unemployment, and growth of production. The consumer price index is a common measure of inflation. Unemployment equals the percent of the labor force that is without a job but looking for work. Gross domestic product is a measure of the growth of production and growth of the economy.

## 3.3 Business Cycles and Economic Activity

The business cycle is the repeated pattern of the economy experiencing expansion, a peak, contraction, and a trough. During the expansion, the economy is growing and real GDP is rising. During a contraction, also known as a recession, the economy is slowing down.

## 3.4 Interest Rates

The interest rate is the rental price of money. The nominal interest rate is the quoted, or stated, rate of interest. The real rate of interest equals the nominal interest rate minus the inflation rate. Lenders charge a risk premium to compensate them for lending to higher-risk borrowers.

## 3.5 Foreign Exchange Rates

A foreign exchange rate is the price of a currency in terms of another currency. If a currency will purchase more of a foreign currency than it would previously, the purchasing currency is said to have appreciated. If a currency will purchase less of a foreign currency than it would previously, the purchasing currency is said to have depreciated.

## 3.6 Sources and Characteristics of Economic Data

One of the most comprehensive sources of economic data is the FRED database, maintained by the Federal Reserve Bank of St. Louis. Over 765,000 time series of data are available. In addition to being viewable in graphical and text form on the FRED site, the data is easily downloaded into an Excel spreadsheet for analysis.

# Key Terms

**business cycle** a period of economic expansion followed by economic contraction
**ceteris paribus** holding all other things constant
**consumer price index (CPI)** a measure of inflation based on the cost of a market basket of goods that a typical urban family of four might purchase
**core inflation index** a measure of inflation that removes food and energy prices from the CPI
**demand** the quantity of a good or service that consumers are willing and able to purchase during a given time period, ceteris paribus
**economic exposure** the risk that a change in exchange rates will impact a business's sales and number of customers
**equilibrium** the point at which the demand and supply curves for a good or service intersect
**equilibrium price** the price at which quantity demanded equals quantity supplied
**expansion** the part of the business cycle in which GDP is growing

**GDP deflator** a measure of inflation tracked by the Bureau of Economic Analysis, intended to measure what GDP would be if prices did not change from one year to the next
**gross domestic product (GDP)** the market value of all goods and services produced within an economy during a year
**inflation** a general increase in prices
**law of demand** the principle that the quantity of purchases varies inversely with price; the higher the price, the lower the quantity
**macroeconomics** the study of the economy as a whole, focusing on unemployment, inflation, and total output
**microeconomics** the study of the economy at the individual level, focusing on how individuals and businesses choose to allocate scarce resources
**nominal interest rate** the quoted or stated interest rate
**producer price index (PPI)** a measure of the prices that producers of goods and services pay for their supplies and raw materials
**real interest rate** the nominal interest rate minus the rate of inflation
**recession** the part of the business cycle characterized by contraction
**spot exchange rate** the price to immediately buy one currency in terms of another currency
**supply** the quantity of a good or service that firms are willing to sell in the market during a given time period, ceteris paribus
**transaction exposure** the risk that the value of a business's expected receipts or expenses will change as a result of a change in currency exchange rates
**translation exposure** the risk that a change in exchange rates will impact the financial statements of a company
**unemployed** members of the labor force who are not currently working but are actively seeking a job

## CFA Institute

This chapter supports some of the Learning Outcome Statements (LOS) in this CFA® Level I Study Session (https://openstax.org/r/cfa-study-session-4-economics). Reference with permission of CFA Institute.

## Multiple Choice

1. Demand is the _____.
   a. amount of a good or service that consumers need
   b. amount of a good or service that consumers want to purchase at the equilibrium price
   c. quantity of a good or service that consumers want to purchase minus the amount that producers are currently supplying
   d. quantity of a good or service that consumers are willing to purchase at various prices over a given time period, ceteris paribus

2. An increase in supply will lead to _____.
   a. a lower equilibrium price and a lower equilibrium quantity
   b. a higher equilibrium price and a lower equilibrium quantity
   c. a higher equilibrium price and a higher equilibrium quantity
   d. a lower equilibrium price and a higher equilibrium quantity

3. An increase in the price of a basket of goods is known as _____.
   a. inflation
   b. falling GDP
   c. rising GDP
   d. a change in quantity demanded

4. The unemployment rate equals _____.

**a.** the number of people unemployed divided by the labor force
**b.** the number of people seeking work divided by the adult population
**c.** the number of people unemployed divided by the number of people employed
**d.** the number of people unemployed plus the number of people working part-time divided by the adult population

**5**. To be considered unemployed, an individual must be _____.
**a.** out of work
**b.** actively seeking a job
**c.** able to work
**d.** All of the above

**6**. When measuring GDP, purchases are divided into the four broad categories of _____.
**a.** interest rates, inflation, unemployment, and investment
**b.** demand, inflation, interest rates, and government spending
**c.** imports, exports, loanable funds, and government spending
**d.** consumer spending, investment, government spending, and net exports

**7**. A business cycle is measured from _____.
**a.** one peak to the next trough
**b.** one trough to the next trough
**c.** one trough to the next peak
**d.** the time of the highest unemployment rate to the time of the lowest unemployment rate

**8**. Which of the following economic environments would most likely be associated with a recession?
**a.** Unemployment falling to 30-year low
**b.** GDP growing at an annual rate of 4.2%
**c.** Unemployment increasing from 5% to 9% during the year
**d.** New businesses opening in record numbers while new housing starts reach a 10-year high

**9**. The interest rate is the _____.
**a.** rental cost of money
**b.** increase in the price of a market basket of goods
**c.** measure of economic activity
**d.** speed at which the money supply is increasing

**10**. If the nominal interest rate is 9% and the rate of inflation is 2%, the real rate of interest is approximately _____.
**a.** $\frac{2}{9}\%$
**b.** 7%
**c.** 11%
**d.** 18%

**11**. A foreign exchange rate is _____.
**a.** the rate of inflation in a foreign country
**b.** the amount of imports a country has relative to its exports
**c.** the price of one currency in terms of another currency
**d.** the rate of unemployment in one country compared to the rate in another country

**12**. In 2020, the CPI in a country is 120. In 2021, the CPI in the same country is 126. This would mean that inflation is _____.
**a.** 5%
**b.** 6%
**c.** 26%

**d.** 46%

## Review Questions

1. Explain the difference between an increase in demand and an increase in quantity demanded.
2. You see that price of laptop computers is falling at the same time that the quantity of laptop computers is rising. Would you attribute this to a change in supply or a change in demand for computers? Explain.
3. Outline the stages of the business cycle.
4. Use a graph of the supply of loanable funds and demand for loanable funds to explain what will happen if the Federal Reserve increases the money supply. What would you expect to happen to the interest rate when this occurs?
5. Your bank offers you a car loan with an interest rate of 6%. You expect inflation to be 2%. What is the real interest rate on this loan?
6. You see that First National Bank is willing to make you a four-year $40,000 car loan with an interest rate of 4.2%. However, the same bank will charge you 16.5% interest on a credit card that it issues. Why is the interest rate on the credit card so much higher than the interest rate on the car loan?
7. Last year, the exchange rate between the Korean won and the US dollar was $\text{KWN } 1020 = \text{USD } 1$. This year, the exchange rate is $\text{KWN } 1150 = \text{USD } 1$. Has the Korean won appreciated or depreciated over the past year? Explain.

## Problems

1. You are planning a budget for an upcoming trip to Japan. Your hotel will cost 12,000 yen per night, and you will stay in the hotel for six nights. If the current exchange rate is $\text{YEN } 98 = \text{USD } 1$, how much will the hotel stay cost you in US dollars?
2. Visit the Federal Reserve Bank of St. Louis's FRED site. Create a graph that plots the unemployment rate for men and the unemployment rate for women since 1948. Turn recession shading on so that you can tell when recession occurred. Are there any patterns that you detect when looking at your chart?

## Video Activity

### Should Investors Prepare for Inflation or Hyperinflation?

Access multimedia content (http://openstax.org/books/principles-finance/pages/3-video-activity)

Inflation is a general increase in the price level. If inflation is extremely high, hyperinflation is said to exist. The video *Inflation or Hyperinflation - How to Prepare for the Coming Rise* by Financial Fast Lane discusses how to survive in an inflationary environment.

1. How might the Federal Reserve's response to the economic conditions that existed in the wake of the COVID-19 pandemic lead to a higher rate of inflation than the United States has experienced over the previous few decades?
2. What suggestions does the video provide to investors who want to protect the value of their savings from being negatively impacted by inflation? Do some research to find out how much inflation has occurred since the spring of 2021 and how an investor who followed the advice would have fared.

### Unemployment Explained

Access multimedia content (http://openstax.org/books/principles-finance/pages/3-video-activity)

The video *Unemployment Explained*, produced by the International Monetary Fund (IMF), explores how economists think about unemployment. The basic economic tools of supply and demand are used to explain

what causes unemployment. In this video, you will also learn about how economists categorize different types of unemployment and why a zero rate of unemployment is not likely or even desirable.

3. List the types of unemployment presented in the video, giving an example of each type.
4. Choose three countries and find out what unemployment has been in each of those countries over the past decade. Do you detect any patterns in the unemployment rates in those countries over time or across the three different countries? Tell which type of unemployment you think has been most prevalent in each country, and explain your reasoning.

4

# Accrual Accounting Process

**Figure 4.1** Accrual accounting reports revenue when goods are delivered or services are performed but are not necessarily paid for. (credit: modification of work "Reviewing Financial Statements" by Instructional Institutions)

## Chapter Outline


**4.1** Cash versus Accrual Accounting
**4.2** Economic Basis for Accrual Accounting
**4.3** How Does a Company Recognize a Sale and an Expense?
**4.4** When Should a Company Capitalize or Expense an Item?
**4.5** What Is "Profit" versus "Loss" for the Company?


## Why It Matters

Emma, an accounting major, was on her way to her Wednesday morning accounting class with her friend Sam. Sam, a finance major, kept complaining to Emma that he didn't enjoy their accounting class at all. "Why do we have to spend so much time worried about debits, credits, accounts, and all this other accounting jargon anyway? I'm a finance major. I won't be spending my days recording entries and counting pennies. I'm dreading class today. I looked at the syllabus, we're studying the accrual method. So what? Just give me the financial statements so I have the data I need."

Emma smiled at her friend and thought for a moment before responding. Emma loves the details of debits, credits, and "all that other accounting jargon," as Sam put it. She knows that while not everyone enjoys the details or understands them, they do play a big role in the timing and accuracy of financial statements. "Yeah, yeah, Sam, accounting isn't always easy or fun, but it's important. The financial statements you will use in finance are a part of the foundation for many decisions. They are an important tool. Even though you don't have to create financial statements in a finance role, it's still necessary to understand the accounting principles they are based on. We haven't covered the details yet, but I do know that income or loss in a period can be significantly different if the income statement is prepared under cash versus accrual methods. I would think that would be important to know if you are the one using the income statement."

# 4.1 Cash versus Accrual Accounting

## Learning Outcomes

By the end of this section, you will be able to:

- Outline the key concepts of the cash-basis accounting method.
- Explain the key characteristics of the accrual-basis accounting method.
- Identify businesses for which cash accounting or accrual accounting is more appropriate.

In this section, we will explore the basic elements of cash and accrual accounting and the businesses that are most likely to use each one. Some private companies may choose to use **cash-basis accounting** rather than **accrual-basis accounting** to report financial information.

## Cash-Basis Accounting

In business, cash is certainly important. In fact, it's so important that it dictates one of two ways we can account for our business transactions. The *cash method* is just as the name implies—it records transactions only when cash flows. We track cash inflows and outflows as they occur. This method is most commonly used by small businesses that deal primarily in cash transactions. The other method, called the *accrual method*, records transactions when they occur, rather than waiting for cash to be accumulated. Using the accrual method, we match cash inflows and the outflows required to generate them. We call this the *matching principle*. This method is used by most publicly traded companies. In this chapter, you'll explore both methods, see how each impacts financial statements differently, note the role of timing in each method, and learn how and when to record capital and expense transactions.

Let's look at an example. Chris just finished the first month of her landscaping business operations at the end of August, and she used the cash method of accounting to figure out her **net income**. Most small start-up companies use the cash method of accounting because it is easy to understand, requires no special training, and helps them focus on one big key to their survival—cash. This means that she simply recorded the cash that came in and the cash that went out of her business. She brought in $1,400 in revenue in her first month, which she felt was substantial given that it was her first month. But after deducting her expenses, she had only $250 left, so she worried about the future of her business. Would she have to increase her sales exponentially in order to start bringing in a decent profit each month?

As you move through the chapter, you'll get to see the impact of the two methods of accounting and how these methods impact the insights and decisions Chris made for her new business.

Cash-basis accounting is a method of accounting in which transactions are not recorded in the financial statements until there is an exchange of cash. Cash-basis accounting sometimes impacts the timing of **revenue** and **expense** reporting until cash receipts or outlays occur. For example, as you saw above, Chris measured the performance of her landscaping business for the month of August using cash flows. Cash accounting is far simpler to track than accrual-basis accounting.

## Accrual-Basis Accounting

Public companies reporting their financial positions use either US generally accepted accounting principles (GAAP) or International Financial Reporting Standards (IFRS), as allowed under the Securities and Exchange Commission (SEC) regulations. GAAP is a set of accounting standards created by the Financial Accounting Standards Board (FASB) and the Governmental Accounting Standards Board (GASB). It's key to note that though they are similar in many areas, there are still key areas that differ between GAAP and IFRS. Therefore, when using financial statements, it's important to be aware of the standards under which they were prepared. However, public or private companies using GAAP or IFRS must prepare their financial statements using the rules of accrual accounting. Accrual-basis accounting prescribes that revenues and expenses must be recorded in the accounting period in which they were earned or incurred, no matter when cash receipts or payments

occur. It is because of accrual accounting that we have the revenue recognition principle and the expense recognition principle (also known as the matching principle).

The accrual method is considered to better match revenues and expenses and standardizes reporting information for comparability purposes. Having comparable information is important to external users of information trying to make investment or lending decisions and to internal users trying to make decisions about company performance, budgeting, and growth strategies.

## Who Uses Each Method?

Cash-basis accounting can be more efficient and well-suited for certain types of businesses, such as farming or professional services provided by lawyers and doctors. However, the accrual basis of accounting is theoretically preferable to the cash basis of accounting because it takes into account the timing of the transactions (when goods and services are provided and when the cash involved in the transactions is received). Cash can often be received a significant amount of time after the initial transaction. Considering this amount allows accountants to provide, in a timely manner, relevant and complete information to stakeholders.

There are several reasons accrual-basis accounting is preferred to cash-basis accounting. Accrual-basis accounting is required by GAAP because it typically provides a better sense of the financial well-being of a company. Accrual-based accounting information allows management to analyze a company's progress, and management can use that information to improve their business. Accrual accounting is also used to assist companies in securing financing because banks will typically require a company to provide accrual-basis financial income statements. The Internal Revenue Service requires businesses to report using accrual-basis information when preparing tax returns. In addition, companies with inventory must use accrual-based accounting for income tax purposes, though there are exceptions to the general rule.

So why might a company use cash-basis accounting? Companies that do not sell stock publicly can use cash-basis instead of accrual-basis accounting for internal management purposes or because they are exempt from such requirements in agreements such as a bank loan. Cash-basis accounting is a simpler accounting system to use than an accrual-basis accounting system when tracking real-time revenues and expenses.

### THINK IT THROUGH

#### Cash- or Accrual-Basis Accounting?

You are a new accountant at a beauty salon. The salon had previously used cash-basis accounting to prepare its financial records but is now considering switching to an accrual-basis method. You have been tasked with determining if this transition is appropriate.

When you go through the records, you notice that this transition will greatly impact how the salon reports revenues and expenses. The salon will now report some revenues and expenses before it receives or pays cash.

How will this change positively impact its business reporting? How will it negatively impact its business reporting? If you were the accountant, would you recommend the salon transition from cash basis to accrual basis?

**Solution:**

Accrual accounting creates a more accurate picture of profit or loss, so the salon's owner can have a better understanding of its profitability from period to period. However, it can be more work to record under accrual accounting. If the salon is small and the profits and costs are easily understood, it might not be worth the extra effort to the owner to use accrual-basis accounting. If the salon is seeking ways to better understand profits and costs, accrual-basis accounting would be a great choice.

# 4.2 Economic Basis for Accrual Accounting

## Learning Outcomes

By the end of this section, you will be able to:

- Assess the impact of business transactions on cash flow.
- Define double-entry accounting and explain how it supports the accounting equation.

How and when we record our transactions can have a significant impact on financial statements, especially the **income statement (net income)**. In this section you will explore the impact business transactions have on financial statements under each method. In doing so, you'll be introduced to **double-entry accounting** and see how it functions to support the accounting equation.

## Timing of Business Activity versus Cash Flow

The first financial statement prepared is the income statement, a statement that shows the organization's financial performance *for a given period of time*. We already saw that Chris, who is a sole proprietor, started a summer landscaping business on August 1, 2020. She categorized her business as a service entity and used the cash-basis method of accounting to record the initial operations for her business. Although Chris was using her family's tractor to get her work done, she was responsible for paying for fuel and any maintenance costs. So, on August 31, Chris realized she had only $250 in her checking account.

This balance was lower than expected because she had spent only slightly less ($1,150 for brakes, fuel, and insurance) than she earned ($1,400)—leaving a net income of $250. While she would like the checking balance to grow each month, she realized that most of the August expenses were infrequent (brakes and insurance) and the insurance, in particular, was an unusually large expense. She knew that the checking account balance would likely grow more in September because she would earn money from some new customers; she also anticipated having fewer expenses.

This simple landscaping example can be used to discuss the elements of the income statement, which are revenues, expenses, **gains**, and **losses** for a particular period of time (see Figure 4.2). Together, these determine whether the organization has net income (where revenues and gains are greater than expenses and losses) or net loss (where expenses and losses are greater than revenues and gains). Revenues, expenses, gains, and losses are further defined in the Income Statement provided.

**Chris's Landscaping**
**Income Statement**
**For the Month Ended August 31**

| | | |
|---|---|---|
| Revenue | $1,400 | |
| Total revenue | | $1,400 |
| Expenses | | |
| Tractor brake repair | 100 | |
| Tractor fuel | 50 | |
| Business insurance | 1,000 | |
| Total expenses | | 1,150 |
| Net income | | $ 250 |

**Figure 4.2 Income Statement for Chris's Landscaping**

The income statement can also be visualized by the formula:

$$\text{Revenue} - \text{Expenses} = \text{Net Income or Net Loss} \quad \textbf{4.1}$$

Let's change this example slightly and assume the $1,000 payment to the insurance company will be paid in

September rather than in August. In this case, the ending balance in Chris's checking account would be $1,250, a result of earning $1,400 and only spending $100 for the brakes on the tractor and $50 for fuel. This stream of cash flows is an example of cash-basis accounting because it reflects when payments are received and made, not necessarily the time period that they affect. At the end of this section, you will address accrual accounting, which does reflect the time period that payments affect.

## The Accounting Equation

It may be helpful to think of the **accounting equation** from a "sources and claims" perspective. Under this approach, the assets (items owned by the organization) were obtained by incurring liabilities or were provided by owners. Stated differently, every asset has a claim against it—by creditors and/or owners.

$$\text{Assets} = \text{Liabilities} + \text{Owner's Equity} \tag{4.2}$$

You may recall from mathematics courses that an equation must always be in balance. Therefore, we must ensure that the two sides of the accounting equation are always equal. We will explore the components of the accounting equation in more detail shortly. First, we need to examine several underlying concepts that form the foundation for the accounting equation: the double-entry accounting system, debits and credits, and the "normal" balance for each account that is part of a formal accounting system.

### THINK IT THROUGH

#### The Accounting Equation

On a sheet of paper, use three columns to create your own accounting equation. In the first column, list all the things you own (assets). List only the asset itself; don't worry about any associated liabilities (expenses) in that column. In the second column, list any amounts owed (the liabilities). When you are done, total up all the assets. Then total up all the liabilities.

Now, use the accounting equation to calculate the net amount of the asset (equity). To do so, subtract the total assets from the total liabilities. This figure makes the accounting equation balance and represents equity, or an estimate of your net worth.

Here is something else to consider: Is it possible to have negative equity? It sure is . . . ask any college student who has taken out loans. At first glance there is no asset directly associated with the amount of the loan. But is that, in fact, the case? You might ask yourself why you should make an investment in a college education—what is the benefit (asset) to going to college? The answer lies in the difference in lifetime earnings with a college degree versus without a college degree. This is influenced by many things, including the supply and demand of jobs and employees. It is also influenced by the earnings for the type of college degree pursued.

**Solution:**

Answers will vary but may include vehicles, clothing, electronics (include cell phones and computer/gaming systems), and sports equipment. They may also include money owed on these assets, most likely vehicles and perhaps cell phones. In the case of a student loan, there may be a liability with no corresponding asset (yet). Responses should be able to evaluate the benefit of investing in college and the wage differential between earnings with and without a college degree.

Let's continue our exploration of the accounting equation, focusing on the equity component in particular. Recall that we defined equity as the net worth of an organization. It is helpful to also think of net worth as the accounting *value* of the organization. Recall, too, that revenues (inflows as a result of providing goods and services) *increase* the accounting value of the organization. So every dollar of revenue an organization generates increases the overall value of the organization.

Likewise, expenses (outflows as a result of generating revenue) *decrease* the value of the organization. So each dollar of expenses an organization incurs decreases the overall value of the organization. The same approach can be taken with the other elements of the financial statements:

- Gains *increase* the value (equity) of the organization.
- Losses *decrease* the value (equity) of the organization.
- Investments by owners *increase* the value (equity) of the organization.
- Distributions to owners *decrease* the value (equity) of the organization.
- Changes in assets and liabilities can *either* increase or decrease the value (equity) of the organization depending on the net result of the transaction.

Let's look at Chris's Landscaping business again and do the same quick exercise you did with your personal finances. If we were to total all of Chris's assets, we would find just one: $250 in cash. She's using the family's tractor, but she doesn't own the tractor, so it is not her asset. Her liabilities are currently $0, as she paid cash for all the expenses she incurred already. If we total her assets, we get $250. Liabilities total $0. Using the accounting equation, we find her equity to currently be $250, or

$$\text{Assets } (\$250) - \text{ Liabilities } (\$0) = \text{Equity } (\$250) \quad \textbf{4.3}$$

## Double-Entry Accounting

Accounting is based on a double-entry accounting system, which requires the following:

- Each time we record a transaction, we must record a change in at least two different accounts. Having two or more accounts change will allow us to keep the accounting equation in balance.
- Not only will at least two accounts change, but there must also be at least one **debit** and one **credit** side impacted.
- The sum of the debits must equal the sum of the credits for each transaction.

In order for companies to record the myriad of transactions they have each year, there is a need for a simple but detailed system. Journals are useful tools to meet this need.

### Debits and Credits

Each account can be represented visually by splitting the account into left and right sides as shown. The graphic representation of a general ledger account is known as a **T-account**. It is called this because it looks like a "T," as you can see with the T-account shown in Figure 4.3.

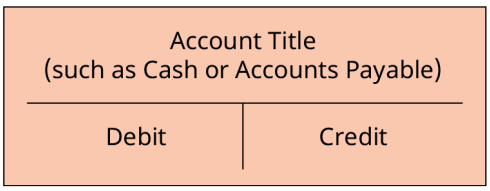


**Figure 4.3 T-Account**

A debit records financial information on the left side of each account. A credit records financial information on the right side of an account. One side of each account will increase, and the other side will decrease. The ending account balance is found by calculating the difference between debits and credits for each account. You will often see the terms *debit* and *credit* represented in shorthand, written as *DR* or *dr* and *CR* or *cr*, respectively. Depending on the account type, the sides that increase and decrease may vary. We can illustrate each account type and its corresponding debit and credit effects in the form of an *expanded* equation (see Figure 4.4).

| Assets | | = Liabilities | | + Equity: Common Stock | | – Dividends | | + Revenues | | – Expenses | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Debit | Credit | Debit | Credit | Debit | Credit | Debit | Credit | Debit | Credit | Debit | Credit |
| Increase | Decrease | Decrease | Increase | Decrease | Increase | Increase | Decrease | Decrease | Increase | Increase | Decrease |

**Figure 4.4 Expanded Accounting Equation**

As we can see from this expanded accounting equation, Assets accounts increase on the debit side and decrease on the credit side. This is also true of Dividends and Expenses accounts. Liabilities increase on the credit side and decrease on the debit side. This is also true of Common Stock and Revenues accounts. This becomes easier to understand as you become familiar with the *normal balance* of an account.

The balance sheet is a reflection of the accounting equation (see Figure 4.5). It has two sections, assets in one section and liabilities and equity in the other section. It's key to note that both assets and liabilities are broken down on the balance sheet into current and noncurrent classifications in order to provide more detail and transparency. Current assets are those that are consumed within a year. Assets that will be in use longer than a year are considered noncurrent. Current liabilities are those that will be due within a year. Noncurrent liabilities are those that are due more than a year into the future.

| Assets | | | | = | Liabilities | | | + | Owner's Equity | |
|---|---|---|---|---|---|---|---|---|---|---|
| Current | | Noncurrent | | | Current | | Noncurrent | | | |
| + | – | + | – | | – | + | – | + | – | + |
| | | | | | | | | | Distribution to Owners<br>Expenses<br>Losses<br>Comprehensive Income | Investments by Owners<br>Revenues<br>Gains<br>Comprehensive Income |

**Figure 4.5 Graphical Representation of the Accounting Equation** Both assets and liabilities are categorized as current and noncurrent. Also highlighted are the various activities that affect the equity (or net worth) of the business.

Notice each account subcategory (Current Assets and Noncurrent Assets, for example) has an "increase" side and a "decrease" side. As you may recall, these are called T-accounts, and they are used to analyze transactions.

The basic components of even the simplest accounting system are *accounts* and a *general ledger*. An account is a record showing increases and decreases to assets, liabilities, and equity—the basic components found in the accounting equation. Each of these categories, in turn, includes many individual accounts, all of which a company maintains in its general ledger. A general ledger is a comprehensive listing of all of a company's accounts with their individual balances.

# 4.3 How Does a Company Recognize a Sale and an Expense?

## Learning Outcomes

By the end of this section, you will be able to:

- Explain the revenue recognition principle and how it relates to current and future sales transactions.
- Explain the expense recognition principle and how it relates to current and future purchase transactions.
- Assess the role of ethics in revenue and expense recognition.

You've learned the basics of each method as well as the accounting equation and double-entry accounting. Next, let's turn our attention to when we record transactions, as timing is key.

## Revenue Recognition

Revenue is the value of goods and services the organization sold or provided to customers for a given period

of time. In our current example, Chris's landscaping business, the "revenue," or the value of services performed, for the month of August would be $1,400. It is the value Chris received in exchange for the services provided to her clients. Likewise, when a business provides goods or services to customers for cash at the time of the service or in the future, the business classifies the amount(s) as revenue. Just as the $1,400 revenues from a business made Chris's checking account balance increase, revenues increase the value of a business. In accounting, **revenue recognition** involves recording sales or fees earned within the period earned. Just as earning wages from a business or summer job reflects the number of hours worked for a given rate of pay or payments from clients for services rendered, revenues (and the other terms) are used to indicate the dollar value of goods and services provided to customers for a given period of time.

THINK IT THROUGH

### Coffee Shop Products

Think about a coffee shop in your area. Identify items the coffee shop sells that would be classified as revenues. Remember, revenues for the coffee shop are related to its primary purpose: selling coffee and related items. Or, better yet, make a trip to the local coffee shop and get a first-hand experience.

**Solution:**

Many coffee shops earn revenue through multiple revenue streams, including coffee and other specialty drinks, food items, gift cards, and merchandise.

## Short-Term Revenue Recognition Examples

Two brief examples may help illustrate the difference between cash accounting and accrual accounting. Assume that a business sells $200 worth of merchandise. In some businesses, there are two ways the customers pay: cash and credit (also referred to as "on account"). Cash sales include checks and credit cards and are paid at the time of the sale. Credit sales (not to be confused with credit card sales) allow the customer to take the merchandise but pay within a specified period of time, usually up to 45 days.

A cash sale would be recorded in the financial statements under both the cash basis and accrual basis of accounting. It makes sense because the customer received the merchandise and paid the business at the same time. It is considered two events that occur simultaneously (exchange of merchandise for cash).

A credit sale, however, would be treated differently under each of these types of accounting. Under the cash basis of accounting, a credit sale would not be recorded in the financial statements until the cash is received, under terms stipulated by the seller. For example, assume that in the next year of Chris's landscaping business, on April 1, she provides $500 worth of services to one of her customers. The sale is made on account, with the payment due 45 days later. Under the cash basis of accounting, the revenue would not be recorded until May 16, when the cash was received. Under the accrual basis of accounting, this sale would be recorded in the financial statements at the time the services were provided, April 1. The reason the sale would be recorded is that, under accrual accounting, the business reports that it provided $500 worth of services to its customer. The fact that the customers will pay later is viewed as a separate transaction under accrual accounting (see Figure 4.6).

Cash ← → Accrual

| Statement of Cash Flows For Month Ended May 31 | | Statement of Cash Flows For Month Ended April 30 | |
|---|---|---|---|
| Cash Flow from Operations | | Cash Flow from Operations | |
| Net Earnings | $500 | Net Earnings | $500 |

**Figure 4.6 Credit versus Cash** On the left is a credit sale recorded under the cash basis of accounting. On the right, the same credit sale is recorded under the accrual basis of accounting.

Let's now explore the difference between the cash basis and accrual basis of accounting using an expense. Assume a business purchases $160 worth of printing supplies from a supplier (vendor). Similar to a sale, a purchase of merchandise can be paid for at the time of sale using cash (also a check or credit card) or at a later date (on account). A purchase paid with cash at the time of the sale would be recorded in the financial statements under both cash basis and accrual basis of accounting. It makes sense because the business received the printing supplies from the supplier and paid the supplier at the same time. It is considered two events that occur simultaneously (exchange of merchandise for cash).

If the purchase was made on account (also called a credit purchase), however, the transaction would be recorded differently under each of these types of accounting. Under the cash basis of accounting, the $160 purchase on account would not be recorded in the financial statements until the cash is paid, as stipulated by the seller's terms. For example, if the printing supplies were received on July 17 and the payment terms were 15 days, no transaction would be recorded until August 1, when the goods were paid for. Under the accrual basis of accounting, this purchase would be recorded in the financial statements at the time the business received the printing supplies from the supplier (July 17). The reason the purchase would be recorded is that the business reports that it bought $160 worth of printing supplies from its vendors. The fact that the business will pay later is viewed as a separate issue under accrual accounting. Table 4.1 summarizes these examples under the different bases of accounting.

| Transaction | Under Cash-Basis Accounting | Under Accrual-Basis Accounting |
|---|---|---|
| $200 sale for cash | Recorded in financial statements at time of sale | Recorded in financial statements at time of sale |
| $200 sale on account | *Not* recorded in financial statements until cash is received | Recorded in financial statements at time of sale |
| $160 purchase for cash | Recorded in financial statements at time of purchase | Recorded in financial statements at time of purchase |
| $160 purchase on account | *Not* recorded in financial statements until cash is paid | Recorded in financial statements at time of purchase |

**Table 4.1 How Transactions Are Viewed under Cash and Accrual Accounting**

Businesses often sell items for cash as well as on account, where payment terms are extended for a period of time (for example, 30 to 45 days). Likewise, businesses often purchase items from suppliers (also called vendors) for cash or, more likely, on account. Under the cash basis of accounting, these transactions would not be recorded until the cash is exchanged. In contrast, under accrual accounting, the transactions are recorded when the transaction occurs, regardless of when the cash is received or paid.

## CONCEPTS IN PRACTICE

### Ethics in Revenue Recognition

Because each industry typically has a different method for recognizing income, revenue recognition is one of the most difficult tasks for accountants, as it involves a number of ethical dilemmas related to income reporting. To provide an industry-wide approach, Accounting Standards Update No. 2014-09 and other related updates were implemented to clarify revenue recognition rules. The American Institute of Certified Public Accountants (AICPA) announced that these updates would replace US GAAP's current industry-specific revenue recognition practices with a principle-based approach, potentially affecting both day-to-day business accounting and the execution of business contracts with customers.[1] The AICPA and the International Federation of Accountants (IFAC) require professional accountants to act with due care and to remain abreast of new accounting rules and methods of accounting for different transactions, including revenue recognition.

The IFAC emphasizes the role of professional accountants working within a business in ensuring the quality of financial reporting: "Management is responsible for the financial information produced by the company. As such, professional accountants in businesses therefore have the task of defending the quality of financial reporting right at the source where the numbers and figures are produced!"[2] In accordance with proper revenue recognition, accountants do not recognize revenue before it is earned.

## CONCEPTS IN PRACTICE

### Gift Card Revenue Recognition

Gift cards have become an essential part of revenue generation and growth for many businesses. Although they are practical for consumers and are a low cost for businesses, navigating revenue recognition guidelines can be difficult. Gift cards with expiration dates require that revenue recognition be delayed until customer use or expiration. However, most gift cards now have no expiration date. So when do you recognize revenue?

Companies may need to provide an estimation of projected (or deferred) gift card revenue and usage during a period based on past experience or industry standards. There are a few rules governing reporting. If a company determines that a portion of all the issued gift cards will never be used, it may write this off to income. In some states, if a gift card remains unused, in part or in full, the unused portion of the card is transferred to the state government. It is considered unclaimed property for the customer, meaning that the company cannot keep these funds as revenue because, in this case, they have reverted to the state government.

## Expense Recognition

An expense is a cost associated with providing goods or services to customers. In our opening example, the expenses that Chris incurred totaled $1,150 (consisting of $100 for brakes, $50 for fuel, and $1,000 for insurance). You might think of expenses as the opposite of revenue, in that expenses reduce Chris's checking account balance. Likewise, expenses decrease the value of the business and represent the dollar value of costs incurred to provide goods and services to customers for a given period of time.

1 American Institute of Certified Public Accountants (AICPA). "Revenue Recognition." n.d. https://www.aicpa.org/interestareas/frc/accountingfinancialreporting/revenuerecognition.html

2 Len Jui and Jessie Wong. "Roles and Importance of Professional Accountants in Business." *China Accounting Journal*. October 21, 2013. https://www.ifac.org/news-events/2013-10/roles-and-importance-professional-accountants-business

THINK IT THROUGH

### Coffee Shop Expenses

While thinking about or visiting a coffee shop in your area, look around (or visualize) and identify items or activities that are the expenses of the coffee shop. Remember, expenses for the coffee shop are related to resources consumed while generating revenue from selling coffee and related items. Do not forget about any expenses that might not be so obvious—as a general rule, every activity in a business has an associated cost.

**Solution:**

Costs of the coffee shop that might be readily observed would include rent, wages for the employees, and the cost of the coffee, pastries, and other items/merchandise that may be sold. In addition, costs such as utilities, equipment, and cleaning or other supplies might also be readily observable. More obscure costs of the coffee shop would include insurance, regulatory costs such as health department licensing, point-of-sale/credit card costs, advertising, donations, and payroll costs such as workers' compensation, unemployment, and so on. There are also unseen costs, such as aging of the building (if owned by the coffee shop) and wear and tear or aging of the equipment.

## 4.4 When Should a Company Capitalize or Expense an Item?

### Learning Outcomes

By the end of this section, you will be able to:

- Define the key characteristics of a fixed asset.
- Explain how the cost of a fixed asset is spread throughout its useful life via depreciation.
- Assess the impact to net income of expensing versus capitalizing an item.

Assets are items a business owns. For accounting purposes, assets are categorized as current versus long term and tangible versus intangible. Any asset that is expected to be used by the business for more than one year is considered a **long-term asset**. These assets are not intended for resale and are anticipated to help generate revenue for the business in the future. Some common long-term assets are computers and other office machines, buildings, vehicles, software, computer code, and copyrights. Although these are all considered long-term assets, some are tangible and some are intangible.

To better understand the nature of fixed assets, let's get to know Liam and their new business. Liam is excited to be graduating from their MBA program and looks forward to having more time to pursue their business venture. During one of their courses, Liam came up with the business idea of creating trendy workout attire. For their class project, they started silk-screening vintage album cover designs onto tanks, tees, and yoga pants. They tested the market by selling their wares on campus and were surprised how quickly and how often they sold out. In fact, sales were high enough that they decided to go into business for themselves. One of their first decisions involved whether they should continue to pay someone else to silk-screen their designs or do their own silk-screening. To do their own silk-screening, they would need to invest in a silk screen machine.

Liam will need to analyze the purchase of a silk screen machine to determine the impact on their business in the short term as well as the long term, including the accounting implications related to the expense of this machine. Liam knows that over time, the value of the machine will decrease, but they also know that an asset is supposed to be recorded on the books at its historical cost. They also wonder what costs are considered part of this asset. Additionally, Liam has learned about the matching principle (**expense recognition**) but needs to learn how that relates to a machine that is purchased in one year and used for many years to help generate revenue. Liam has a lot of information to consider before making this decision.

## What Is a Fixed Asset?

An asset is considered a **tangible asset** when it is an economic resource that has physical substance—it can be seen and touched. Tangible assets can be either short term, such as inventory and supplies, or long term, such as land, buildings, and equipment. To be considered a long-term tangible asset, the item needs to be used in the normal operation of the business for more than one year, be of material value, and not be near the end of its useful life, and the company must have no plan to sell the item in the near future. The useful life is the time period over which an asset cost is allocated. Long-term tangible assets are known as fixed assets. It's also key to note that companies will **capitalize** a fixed asset if they have material value. A $10 stapler to be used in the office, for example, may last for years, but the value of the item is not significant enough to warrant capitalizing it.

Businesses typically need many different types of these assets to meet their objectives. These assets differ from the company's products. For example, the computers that Apple, Inc. intends to sell are considered inventory (a short-term asset), whereas the computers Apple's employees use for day-to-day operations are long-term assets. In Liam's case, the new silk screen machine would be considered a long-term tangible asset as they plan to use it over many years to help generate revenue for their business. Long-term tangible assets are listed as noncurrent assets on a company's balance sheet. Typically, these assets are listed under the category of Property, Plant, and Equipment (PP&E), but they may be referred to as fixed assets or plant assets.

Apple, Inc. lists a total of $36.766 million in total Property, Plant, and Equipment (net) on its September 2020 consolidated balance sheet (see Figure 4.7). As shown in the figure, this net total includes land and buildings, machinery, equipment and internal-use software, and leasehold improvements, resulting in a gross PP&E of $103.526 million—less accumulated depreciation and amortization of $66.760 million—to arrive at the net amount of $36.766 million.

| | 2020 | 2019 |
|---|---|---|
| Land and Buildings | $ 17,952 | $ 17,085 |
| Machinery, Equipment, and Internal-Use Software | 75,291 | 69,797 |
| Leasehold Improvements | 10,283 | 9,075 |
| **Gross Property, Plant, and Equipment** | **103,526** | **95,957** |
| Accumulated Depreciation and Amortization | (66,760) | (58,579) |
| **Total Property, Plant, and Equipment, Net** | **$ 36,766** | **$ 37,378** |

**Figure 4.7 Apple's Property, Plant, and Equipment, Net (September 2020, in $ million)**[3] This report shows the company's consolidated financial statement details as of September 30, 2020, and September 30, 2019.

### THINK IT THROUGH

#### Classifying Assets and Related Expenditures

You work at a business consulting firm. Your new colleague, Milan, is helping a client company organize its accounting records by types of assets and expenditures. Milan is a bit stumped on how to classify certain assets and related expenditures, such as capitalized costs versus expenses. They have given you the following list and asked for your help to sort through it. Help your colleague classify the expenditures as either capitalized or expensed, and note which assets are property, plant, and equipment.

Expenditures:

- Normal repair and maintenance on the manufacturing facility
- Cost of taxes on new equipment used in business operations
- Shipping costs on new equipment used in business operations
- Cost of a minor repair on existing equipment used in business operations

Assets:

- Land next to the production facility held for use next year as a place to build a warehouse
- Land held for future resale when the value increases
- Equipment used in the production process

**Solution:**

Expenditures:

- Normal repair and maintenance on the manufacturing facility: expensed
- Cost of taxes on new equipment used in business operations: capitalized
- Shipping costs on new equipment used in business operations: capitalized
- Cost of a minor repair on existing equipment used in business operations: expensed

Assets:

- Land next to the production facility held for use next year as a place to build a warehouse: property, plant, and equipment
- Land held for future resale when the value increases: investment
- Equipment used in the production process: property, plant, and equipment

Why are the costs of putting a long-term asset into service capitalized and written off as expenses (depreciated) over the economic life of the asset? Let's return to Liam's start-up business as an example. Liam plans to buy a silk screen machine to help create clothing that they will sell. The machine is a long-term asset because it will be used in the business's daily operation for many years. If the machine costs Liam $5,000 and it is expected to be used in their business for several years, GAAP require the allocation of the machine's costs over its useful life, which is the period over which it will produce revenues. Overall, in determining a company's financial performance, we would not expect that Liam should have an expense of $5,000 this year and $0 in expenses for this machine for future years in which it is being used. GAAP addressed this through the expense recognition (matching) principle, which states that expenses should be recorded in the same period with the revenues that the expense helped create. In Liam's case, the $5,000 for this machine should be allocated over the years in which it helps to generate revenue for the business. Capitalizing the machine allows this to occur. As stated previously, to capitalize is to record a long-term asset on the balance sheet and expense its allocated costs on the income statement over the asset's economic life. Therefore, when Liam purchases the machine, they will record it as an asset on the financial statements (see journal entry in Figure 4.8).

| Journal | | | |
|---|---|---|---|
| **Date** | **Account** | **Debit** | **Credit** |
| Jan. 1 | Machine<br>Cash | 5,000 | <br>5,000 |

**Figure 4.8 Journal Entry for Machine/Cash**

When capitalizing an asset, the total cost of acquiring the asset is included in the cost of the asset. This includes additional costs beyond the purchase price, such as shipping costs, taxes, assembly, and legal fees. For example, if a real estate broker is paid $8,000 as part of a transaction to purchase land for $100,000, the land would be recorded at a cost of $108,000.

Over time, as the asset is used to generate revenue, Liam will need to depreciate recognize the cost of the asset.

3 In the Chapter 4 financial statements, a number contained within parentheses is a negative number, such as the "Accumulated depreciation and amortization" line item.

## What Is Depreciation?

When a business purchases a long-term asset (used for more than one year), it classifies the asset based on whether the asset is used in the business's operations. If a long-term asset is used in the business's operations, it will belong in property, plant, and equipment or intangible assets. In this situation, the asset is typically capitalized. Capitalization is the process by which a long-term asset is recorded on the balance sheet and its allocated costs are expensed on the income statement over the asset's economic life.

Long-term assets that are not used in daily operations are typically classified as an investment. For example, if a business owns land on which it operates a store, warehouse, factory, or offices, the cost of that land would be included in property, plant, and equipment. However, if a business owns a vacant piece of land on which the business conducts no operations (and assuming no current or intermediate-term plans for development), the land would be considered an investment.

**Depreciation** is the process of allocating the cost of a tangible asset over its useful life, or the period of time that the business believes it will use the asset to help generate revenue.

### Fundamentals of Depreciation

As you have learned, when accounting for a long-term fixed asset, we cannot simply record an expense for the cost of the asset and record the entire outflow of cash in one accounting period. Like all other assets, when you purchase or acquire a long-term asset, it must be recorded at the historical (initial) cost, which includes all costs to acquire the asset and put it into use. The initial recording of an asset has two steps:

1. Record the initial purchase on the date of purchase, which places the asset on the balance sheet (as property, plant, and equipment) at cost, and record the amount as notes payable, accounts payable, or an outflow of cash.
2. At the end of the period, make an adjusting entry to recognize the depreciation expense. Depreciation expense is the amount of the asset's cost to be recognized, or expensed, in the current period. Companies may record depreciation expense incurred annually, quarterly, or monthly.

Following GAAP and the expense recognition principle, the depreciation expense is recognized over the asset's estimated useful life.

### Recording the Initial Asset

Assets are recorded on the balance sheet at cost, meaning that all costs to purchase the asset and to prepare the asset for operation should be included. Costs outside of the purchase price may include shipping, taxes, installation, and modifications to the asset.

The journal entry to record the purchase of a fixed asset (assuming that a note payable, not a short-term account payable, is used for financing) is shown in Figure 4.9.

| Journal | | | |
|---|---|---|---|
| **Date** | **Account** | **Debit** | **Credit** |
| Jan. 1 | Fixed Asset (truck, building, etc.)<br>Cash/Notes Payable<br>*To record purchase of fixed asset* | XXX | <br>XXX |

**Figure 4.9 Journal Entry for Fixed Asset**

Applying this to Liam's silk-screening business, we learn that they purchased their silk screen machine for $54,000 by paying $10,000 cash and the remainder in a note payable over five years. The journal entry to record the purchase is shown in Figure 4.10.

| Journal | | | |
|---|---|---|---|
| **Date** | **Account** | **Debit** | **Credit** |
| Jan. 1 | Equipment | 54,000 | |
| | Cash | | 10,000 |
| | Notes Payable | | 44,000 |
| | *To recognize purchase of silk-screening machine* | | |

**Figure 4.10 Journal Entry for Equipment/Cash**

## CONCEPTS IN PRACTICE

### Estimating Useful Life and Salvage Value

Useful life and salvage value are estimates made at the time an asset is placed in service. It is common and expected that the estimates are inaccurate due to the uncertainty involved in estimating the future. Sometimes, however, a company may attempt to take advantage of estimating salvage value and useful life to improve earnings. A larger salvage value and longer useful life decrease annual depreciation expense and increase annual net income. An example of this behavior is Waste Management, which was disciplined by the SEC in March 2002 for fraudulently altering its estimates to reduce depreciation expense and overstate net income by $1.7 billion.[4]

## Components Used in Calculating Depreciation

The expense recognition principle that requires that the cost of the asset be allocated over the asset's useful life is the process of depreciation. For example, if we buy a delivery truck to use for the next five years, we would allocate the cost and record depreciation expense across the entire five-year period. The calculation of the depreciation expense for a period is not based on anticipated changes in the fair-market value of the asset; instead, the depreciation is based on the allocation of the cost of owning the asset over the period of its useful life.

The following items are important in determining and recording depreciation:

- Book value: the asset's original cost less accumulated depreciation.
- Useful life: the length of time the asset will be productively used within operations.
- Salvage (residual) value: the price the asset will sell for or be worth as a trade-in when its useful life expires. The determination of salvage value can be an inexact science since it requires anticipating what will occur in the future. Often, the salvage value is estimated based on past experiences with similar assets.
- Depreciable base (cost): the depreciation expense over the asset's useful life. For example, if we paid $50,000 for an asset and anticipate a salvage value of $10,000, the depreciable base is $40,000. We expect $40,000 in depreciation over the time period in which the asset was used, and then it would be sold for $10,000.

Depreciation records an expense for the value of an asset consumed and removes that portion of the asset from the balance sheet. The journal entry to record depreciation is shown in Figure 4.11.

4 United States Securities and Exchange Commission. "Waste Management, Inc. Founder and Five Other Former Top Officers Sued for Massive Earnings Management Fraud." March 26, 2002. https://www.sec.gov/litigation/litreleases/lr17435.htm

| Journal | | | |
|---|---|---|---|
| **Date** | **Account** | **Debit** | **Credit** |
| Jan. 1 | Depreciation Expense | XXX | |
| | Accumulated Depreciation | | XXX |
| | *To record depreciation on asset for period* | | |

**Figure 4.11 Journal Entry for Depreciation Expense**

Depreciation expense is a common operating expense that appears on an income statement. It represents the amount of expense being recognized in the current period. Accumulated depreciation, on the other hand, represents the sum of all depreciation expense recognized to date, or the total of all prior depreciation expense for the asset. It is a contra account, meaning it is attached to another account and is used to offset the main account balance that records the total depreciation expense for a fixed asset over its life. In this case, the asset account stays recorded at the historical value but is offset on the balance sheet by accumulated depreciation. Accumulated depreciation is subtracted from the historical cost of the asset on the balance sheet to show the asset at book value. Book value is the amount of the asset that has not been allocated to expense through depreciation.

It is important to note, however, that not all long-term assets are depreciated. For example, land is not depreciated because depreciation is the allocating of the expense of an asset over its useful life. How can one determine a useful life for land? It is assumed that land has an unlimited useful life; therefore, it is not depreciated, and it remains on the books at historical cost.

Once it is determined that depreciation should be accounted for, there are three methods that are most commonly used to calculate the allocation of depreciation expense: the *straight-line method*, the *units-of-production method*, and the *double-declining-balance method*. A fourth method, the *sum-of-the-years-digits* method, is another *accelerated* option that has been losing popularity and can be learned in intermediate accounting courses. Note that these methods are for accounting and reporting purposes. The IRS allows firms to use the same or different methods to depreciate assets in calculating taxable income.

## THINK IT THROUGH

### Fixed Assets

You work for Georgia-Pacific as an accountant in charge of the fixed assets subsidiary ledger at a production and warehouse facility in Pennsylvania. The facility is in the process of updating and replacing several asset categories, including warehouse storage units, fork trucks, and equipment on the production line. It is your job to keep the information in the fixed assets subsidiary ledger up to date and accurate. You need information on original historical cost, estimated useful life, salvage value, depreciation methods, and additional capital expenditures. You are excited about the new purchases and upgrades to the facility and how they will help the company serve its customers better. However, you have been in your current position for only a few years and have never overseen extensive updates, and you realize that you will have to gather a lot of information at once to keep the accounting records accurate. You feel overwhelmed and take a minute to catch your breath and think through what you need. After a few minutes, you realize that you have many people and many resources to work with to tackle this project. Whom will you work with, and how will you go about gathering what you need?

**Solution:**

Though answers may vary, common resources would likely include purchasing managers (those actually buying the new equipment), maintenance managers (those who will repair and take care of the new equipment), and line managers (those in charge of the departments that will use the new equipment). To

gather the information needed, set up short meetings to visit with the individuals involved, walk around to see the equipment, and ask questions about functionality, life span, common problems or repairs, and more.

Assume that on January 1, Liam bought a silk screen machine for $54,000. Liam pays shipping costs of $1,500 and setup costs of $2,500 and assumes a useful life of five years or 960,000 prints. Based on experience, Liam anticipates a salvage value of $10,000. Recall that determination of the costs to be depreciated requires including all costs that prepare the asset for use by the company. Liam's example would include shipping and setup costs. Any costs for maintaining or repairing the equipment would be treated as regular expenses, so the total cost would be $58,000, and after allowing for an anticipated salvage value of $10,000 in five years, the business could take $48,000 in depreciation over the machine's economic life (see Figure 4.12).

| | **Total Cost** |
|---|---|
| Purchase Price | $ 54,000 |
| Shipping Costs | 1,500 |
| Set-up Costs | 2,500 |
| Total Cost | $ 58,000 |
| – Salvage Value | (10,000) |
| Depreciable Base | $ 48,000 |

**Figure 4.12 Purchase Price and Depreciable Base**

Straight-line depreciation is a method of depreciation that evenly splits the depreciable amount across the useful life of the asset. Therefore, we must determine the yearly depreciation expense by dividing the depreciable base of $48,000 by the economic life of five years, giving an annual depreciation expense of $9,600. The journal entries to record the first two years of expenses are shown, along with the balance sheet information. Here are the journal entry and information for year one (Figure 4.13):

| Journal | | | |
|---|---|---|---|
| **Date** | **Account** | **Debit** | **Credit** |
| Dec. 31 | Depreciation Expense: Silk Screen Machine | 9,600 | |
| | Accumulated Depreciation: Silk Screen Machine | | 9,600 |
| | *To record depreciation on asset for period* | | |

| | |
|---|---|
| Silk Screen Machine | $ 58,000 |
| – Accumulated Depreciation: Silk Screen Machine | (9,600) |
| Net Book Value | $ 48,400 |

**Figure 4.13 Journal Entry for Silk Screen Machine Depreciation Expense, Year 1**

After the journal entry in year one, the machine would have a book value of $48,400. This is the original cost of $58,000 less the accumulated depreciation of $9,600. The journal entry and information for year two are shown in Figure 4.14.

| Journal | | | |
|---|---|---|---|
| **Date** | **Account** | **Debit** | **Credit** |
| Dec. 31 | Depreciation Expense: Silk Screen Machine | 9,600 | |
| | Accumulated Depreciation: Silk Screen Machine | | 9,600 |
| | *To record depreciation on asset for period* | | |

| | |
|---|---|
| Silk Screen Machine | $ 58,000 |
| – Accumulated Depreciation: Silk Screen Machine | (19,200) |
| Net Book Value | $ 38,800 |

**Figure 4.14 Journal Entry for Silk Screen Machine Depreciation Expense, Year 2**

Liam records an annual depreciation expense of $9,600. Each year, the accumulated depreciation balance increases by $9,600, and the machine's book value decreases by the same $9,600. At the end of five years, the asset will have a book value of $10,000, which is calculated by subtracting the accumulated depreciation of $\$48{,}000$ $(5 \times \$9{,}600)$ from the cost of $58,000.

## Units-of-Production Depreciation

Straight-line depreciation is efficient accounting for assets used consistently over their lifetime, but what about assets that are used with less regularity? The units-of-production depreciation method bases depreciation on the actual usage of the asset, which is more appropriate when an asset's life is a function of usage instead of time. For example, this method could account for depreciation of a silk screen machine for which the depreciable base is $48,000 (as in the straight-line method), but now the number of prints is important.

In our example, the machine will have total depreciation of $48,000 over its useful life of 960,000 prints. Therefore, we would divide $48,000 by 960,000 prints to get a cost per print of $0.05. If Liam printed 180,000 items in the first year, the depreciation expense would be $180{,}000 \text{ prints} \times \$0.05 \text{ per print}$, or $\$9{,}000$. The journal entry to record this expense would be the same as with straight-line depreciation: only the dollar amount would have changed. The presentation of accumulated depreciation and the calculation of the book value would also be the same. Liam would continue to depreciate the asset until a total of $48,000 in depreciation was taken after running 960,000 total prints.

### THINK IT THROUGH

#### Deciding on a Depreciation Method

Liam is struggling to determine which deprecation method they should use for their new silk screen machine. They expect sales to increase over the next five years. They also expect (hope) that in two years they will need to buy a second silk screen machine to keep up with the demand for products of their growing company. Which depreciation method makes more sense for Liam: higher expenses in the first few years or keeping expenses consistent over time? Or would it be better for them to think not in terms of time, but rather in the usage of the machine?

## Double-Declining-Balance Depreciation

The double-declining-balance depreciation method is the most complex of the three methods because it accounts for both time and usage and takes more expense in the first few years of the asset's life. Double declining considers time by determining the percentage of depreciation expense that would exist under straight-line depreciation. To calculate this, divide 100 percent by the estimated life in years. For example, a five-year asset would be 100/5, or 20 percent a year. A four-year asset would be 100/4, or 25 percent a year. Next, because assets are typically more efficient and are used more heavily early in their life span, the double-

declining method takes usage into account by doubling the straight-line percentage. For a four-year asset, multiply 25 percent $(100\%/4\text{-year life}) \times 2$, or 50 percent. For a five-year asset, multiply 20 percent $(100\%/5\text{-year life}) \times 2$, or 40 percent.

One unique feature of the double-declining-balance method is that in the first year, the estimated salvage value is not subtracted from the total asset cost before calculating the first year's depreciation expense. Instead, the total cost is multiplied by the calculated percentage. However, depreciation expense is not permitted to take the book value below the estimated salvage value, as demonstrated in Figure 4.15.

| Year | Depreciation Expense | Accumulated Depreciation | Book Value |
|---|---|---|---|
| | | | $58,000 |
| 1: $58,000 × 40% = | $23,200 | $23,200 | 34,800 |
| 2: $34,800 × 40% = | 13,920 | 37,120 | 20,880 |
| 3: $20,880 × 40% = | 8,352 | 45,472 | 12,528 |
| 4: $12,528 − $10,000 = | 2,528 | 48,000 | 10,000 |
| 5 | 0 | 48,000 | 10,000 |
| Total | $48,000 | $48,000 | $10,000 |

**Figure 4.15 Depreciation Expense, Accumulated Depreciation, and Book Value, Years 1–5**

Notice that in year four, the remaining book value of $12,528 was not multiplied by 40 percent. This is because the expense would have been $5,011.20, and since we cannot depreciate the asset below the estimated salvage value of $10,000, the expense cannot exceed $2,528, which is the amount left to depreciate (difference between the book value of $12,528 and the salvage value of $10,000). Since the asset has been depreciated to its salvage value at the end of year four, no depreciation can be taken in year five.

In our example, the first year's double-declining-balance depreciation expense would be $\$58{,}000 \times 40\%$, or $\$23{,}200$. For the remaining years, the double-declining percentage is multiplied by the remaining book value of the asset. Liam would continue to depreciate the asset until the book value and the estimated salvage value are the same (in this case, $10,000). The net effect of the differences in straight-line depreciation versus double-declining-balance depreciation is that under the double-declining-balance method, the allowable depreciation expenses are greater in the earlier years than those allowed for straight-line depreciation. However, over the depreciable life of the asset, the total depreciation expense taken will be the same no matter which method the entity chooses. In the current example, both straight-line and double-declining-balance depreciation will provide a total depreciation expense of $48,000 over its five-year depreciable life.

## LINK TO LEARNING

### McDonald's Corporation

See Form 10-K (https://openstax.org/r/2019-annual-report-pdf) that was filed with the SEC to determine which depreciation method McDonald's Corporation used for its long-term assets in 2019.

*Hint:* Use the search feature to search for key words in an annual report to find information more quickly. For example, search "depreciation." You should find the information you are looking for on page 40 of the annual report.

Based on the company's business model and the industry in which it operates, why do you think McDonald's chose this method of depreciating assets? Do you agree with this choice? Why or why not?

## Summary of Depreciation

Table 4.2 and Figure 4.16 compare the three methods discussed. Note that although each time-based (straight-line and double-declining balance) annual depreciation expense is different, after five years the total amount depreciated (accumulated depreciation) is the same. This occurs because at the end of the asset's useful life, it was expected to be worth $10,000: thus, both methods depreciated the asset's value by $48,000 over that time period.

| Depreciation Method | Calculation |
|---|---|
| Straight line | $$\text{(Cost} - \text{Salvage Value)/Useful Life} \quad (4.4)$$ |
| Units of production | $$\text{(Cost} - \text{Salvage Value)} \times \text{(Units Produced in Current Period /Estimated Total Units to Be Produced)} \quad (4.5)$$ |
| Double-declining balance | $$\text{Book Value} \times \text{Straight} - \text{Line Annual Depreciation Percentage} \times 2 \quad (4.6)$$ |

**Table 4.2 Three Methods of Calculating Depreciation Expense**

| Period | Straight-Line Depreciation Method | Units of Production Method | | Double-Declining-Balance Method |
|---|---|---|---|---|
| Year 1 | $ 9,600 | (180,000 units) | $ 9,000 | $23,200 |
| Year 2 | 9,600 | (200,000 units) | 10,000 | 13,920 |
| Year 3 | 9,600 | (210,000 units) | 10,500 | 8,352 |
| Year 4 | 9,600 | (190,000 units) | 9,500 | 2,528 |
| Year 5 | 9,600 | (180,000 units) | 9,000 | 0 |
| Total | $48,000 | | $48,000 | $48,000 |

**Figure 4.16 Straight-Line Depreciation, Units of Production, Double-Declining Balance Method, Years 1–5**

When analyzing depreciation, accountants are required to make a supportable estimate of an asset's useful life and its salvage value. However, "management teams typically fail to invest either time or attention into making or periodically revisiting and revising reasonably supportable estimates of asset lives or salvage values, or the selection of depreciation methods, as prescribed by GAAP."[5] This failure is not an ethical approach to properly accounting for the use of assets.

Accountants need to analyze depreciation of an asset over the entire useful life of the asset. As an asset supports the cash flow of the organization, expensing its cost needs to be allocated, not just recorded as an arbitrary calculation. An asset's depreciation may change over its life according to its use. If asset depreciation is arbitrarily determined, the recorded "gains or losses on the disposition of depreciable property assets seen in financial statements"[6] are not true best estimates. Due to operational changes, the depreciation expense needs to be periodically reevaluated and adjusted.

Any mischaracterization of asset usage is not proper GAAP and is not proper accrual accounting. Therefore, "financial statement preparers, as well as their accountants and auditors, should pay more attention to the quality of depreciation-related estimates and their possible mischaracterization and losses of credits and charges to operations as disposal gains."[7] An accountant should always follow GAAP guidelines and allocate the expense of an asset according to its usage.

5 Howard B. Levy. "Depreciable Asset Lives: The Forgotten Estimate in GAAP." *The CPA Journal.* September 2016. cpajournal.com/2016/09/08/depreciable-asset-lives/
6 Ibid.
7 Ibid.

CONCEPTS IN PRACTICE

### Ethical Considerations: How WorldCom's Improper Capitalization of Costs Almost Shut Down the Internet

In 2002, telecommunications giant WorldCom filed for the largest Chapter 11 bankruptcy to date, a situation resulting from manipulation of its accounting records.[8] At the time, WorldCom operated nearly a third of the bandwidth of the 20 largest US internet backbone routes, connecting over 3,400 global networks that serviced more than 70,000 businesses in 114 countries.[9]

WorldCom used a number of accounting gimmicks to defraud investors, mainly including capitalizing costs that should have been expensed. Under normal circumstances, this might have been considered just another accounting fiasco leading to the end of a company. However, WorldCom controlled a large percentage of backbone routes, a major component of the hardware supporting the internet, as even the Securities and Exchange Commission recognized. If such an event were to happen today, it could shut down international commerce and would be considered a national emergency.[10] As demonstrated by WorldCom, the unethical behavior of a few accountants could have shut down the world's online businesses and international commerce. An accountant's job is fundamental and important: keep businesses operating in a transparent fashion.

(Sources: "WorldCom (UNNET)." *Cybertelecom*. n.d. http://www.cybertelecom.org/industry/wcom.htm; Dennis R. Beresford, Nicholas DeB. Katzenbach, and C. B. Rogers, Jr. "Report of the Special Investigative Committee of the Board of Directors of WorldCom, Inc." US Securities and Exchange Commission. March 31, 2003. https://www.sec.gov/Archives/edgar/data/723527/000093176303001862/dex991.htm)

# 4.5 What Is "Profit" versus "Loss" for the Company?

## Learning Outcomes

By the end of this section, you will be able to:

- Outline the components necessary to calculate profit or loss.
- Contrast revenue and gains versus expenses and losses.
- Differentiate revenue and expense versus receipt or payment of cash.

It's a common misconception that if a business has cash they are making a profit, and if they are suffering a loss they must not have any cash. While this could be true, it's not necessarily true. In this section you'll explore key differences between cash flow, revenue, expense, profits, and losses.

## Calculating Profit and Loss

Net income (net loss) is determined by comparing revenues and expenses. Net income is a result of revenues (inflows) being greater than expenses (outflows). A net loss occurs when expenses (outflows) are greater than revenues (inflows). In accounting it is common to present net income in the following format:

Recall that revenue is the value of goods and services a business provides to its customers and increases the value of the business. Expenses, on the other hand, are the costs of providing the goods and services and decrease the value of the business. When revenues exceed expenses, companies have net income. This means the business has been successful at earning revenues, containing expenses, or a combination of both. If, on the other hand, expenses exceed revenues, companies experience a net loss. This means the business was

8 Luisa Beltran. "WorldCom Files Largest Bankruptcy Ever." *CNN Money*. July 22, 2002. https://money.cnn.com/2002/07/19/news/worldcom_bankruptcy/
9 Jeff Keefe. *Monopoly.com: Will the WorldCom–MCI Merger Tangle the Web?* Washington, DC: Economic Policy Institute, 1998. https://www.epi.org/publication/monopoly-will-the-worldcom-mci-merger-tangle-the-web/
10 Dan Schiller. *Bad Deal of the Century: The Worrisome Implications of the WorldCom–MCI Merger.* Washington, DC: Economic Policy Institute, 1998. https://www.epi.org/publication/studies_baddealfull/

unsuccessful in earning adequate revenues, sufficiently containing expenses, or a combination of both. While businesses work hard to avoid net loss situations, it is not uncommon for a company to sustain a net loss from time to time. It is difficult, however, for businesses to remain viable while experiencing net losses over the long term.

Shown as a formula, the net income (loss) function is:

$$\begin{aligned} \text{Revenues } (R) - \text{Expenses } (E) &= \text{Net Income (when } R > E) \\ \text{Revenues } (R) - \text{Expenses } (E) &= \text{Net Loss (when } E > R) \end{aligned} \quad \textbf{4.7}$$

To be complete, we must also consider the impact of gains and losses. While gains and losses are infrequent in a business, it is not uncommon that a business would present a gain and/or loss in its financial statements. Recall that gains are similar to revenue and losses are similar to expenses. Therefore, the traditional accounting format would be as shown in Figure 4.17.

| Gains and Losses |
| --- |
| Revenue (sometimes called Sales or Fees Earned)<br>+ Gains<br>– Expenses<br>– Losses<br>Net Income (or Net Loss) |

**Figure 4.17 Gains and Losses**

Shown as a formula, the net income (loss) function, including gains and losses, is:

$$\text{Revenues } (R) + \text{Gains } (G) - \text{Expenses } (E) - \text{Losses } (L) = \text{Net Income } [\text{when } (R+G) > (E+L)] \quad \textbf{4.8}$$

$$\text{Revenues } (R) + \text{Gains } (G) - \text{Expenses } (E) - \text{Losses } (L) = \text{Net Loss } [\text{when } (E+L) > (R+G)] \quad \textbf{4.9}$$

When assessing a company's net income, it is important to understand the source of the net income. Businesses strive to attain "high quality" net income (earnings). High-quality earnings are based on sustainable earnings, also called permanent earnings, while relying less on infrequent earnings, also called temporary earnings. Recall that revenues represent the ongoing value of goods and services the business provides (sells) to its customers, while gains are infrequent and involve items ancillary to the primary purpose of the business. For example, assume a bakery sells the truck it uses to deliver wedding cakes and experiences a gain on the sale. The bakery is not in the business of buying and selling trucks. It is in the baked goods business. Thus, the gain on the sale of the truck would be ancillary to the primary purpose of the business and represent a gain rather than revenue. We should use caution if a business attains a significant portion of its net income as a result of gains rather than revenues. Likewise, net losses derived as a result of losses should be put into the proper perspective due to the infrequent nature of losses. While net losses are undesirable for any reason, net losses that result from expenses related to ongoing operations, rather than losses that are infrequent, are more concerning for the business.

## Profit versus Cash Flow

Knowing the difference between the cash basis and accrual basis of accounting is necessary to understand the need for the statement of cash flows. Stakeholders need to know the financial performance (as measured by the income statement—that is, net income or net loss) and financial position (as measured by the balance sheet—that is, assets, liabilities, and owners' equity) of the business. This information is provided in the income statement, statement of owner's equity, and balance sheet. However, since these financial statements are prepared using accrual accounting, stakeholders do not have a clear picture of the business's cash activities. The statement of cash flows solves this inadequacy by specifically focusing on the cash inflows and cash outflows. It also helps better delineate the difference between revenues and cash flow in versus expenses and cash flow out. As mentioned in prior sections, revenue can occur without cash actually flowing. For

example, a customer may buy a good on account. Revenues would be recorded, but cash would not yet be received. The same is true on the expenses side. An expense can be incurred, such as an electric bill, but cash may not have been paid out yet. Thus, an expense is recorded and recognized on the income statement, but cash has not yet been given up. The statement of cash flows helps reconcile the difference between net income (a result of recorded revenues and expenses) and actual cash flow.

# Summary

## 4.1 Cash versus Accrual Accounting

Cash-basis accounting records revenues and expenses only when cash is received or distributed. Accrual-basis accounting, on the other hand, records revenues and expenses when they are earned or incurred rather than waiting until cash changes hands. Most publicly traded companies are required by the SEC to use accrual-basis accounting. Generally, smaller businesses that deal primarily in cash are the best candidates for using the cash basis since the accrual method more accurately depicts net income or net loss each period.

## 4.2 Economic Basis for Accrual Accounting

Double-entry accounting means that each time a transaction is recorded, there are at minimum two accounts impacted by the entry. Each entry's debits must total its credits in order to support and maintain the balance in the accounting equation. The accounting equation is expressed as

$$\text{Assets} = \text{Liabilities} + \text{Owner's Equity}. \tag{4.10}$$

## 4.3 How Does a Company Recognize a Sale and an Expense?

In accrual accounting, the timing of revenues (when to record them) is governed by the revenue recognition principle. The principle indicates that revenue is only recognized on the income statement once it is earned. This means goods or services must have been delivered or rendered. Expenses, on the other hand, are guided by the expense recognition principle, which dictates that expenses must be recorded in the period in which they are incurred.

## 4.4 When Should a Company Capitalize or Expense an Item?

Determining when an item is actually an expense depends on whether it is capitalized (a fixed asset) or not. Fixed assets are those that are of significant value and last longer than one year. The cost of fixed assets is capitalized (placed on the balance sheet as an asset) and expensed over the useful life of the asset by recording depreciation. Depreciation can be calculated using straight-line, double-declining-balance, or units-of-production methods.

## 4.5 What Is "Profit" versus "Loss" for the Company?

Profit or loss for a company is calculated by subtracting expenses from revenue. The result is a profit if revenues are larger than expenses. Profit (or loss) is the money earned from the day-to-day general business operations. Gains and losses, on the other hand, occur when the business does something they don't normally do (like sell a piece of their equipment) and earns or loses money on the transaction. It's key to note that the timing of cash flows can vary from the timing of recording revenues or expenses. Thus a revenue does not necessarily equal cash in, and an expense does not necessarily equal a cash flow out.

# Key Terms

**accounting equation** $\text{Assets} = \text{Liabilities} + \text{Owner's Equity}$

**accrual-basis accounting** an accounting system in which revenue is recorded or recognized when earned yet not necessarily received, and in which expenses are recorded when legally incurred and not necessarily when paid

**capitalize** the process in which a long-term asset is recorded on the balance sheet and its allocated costs are expensed on the income statement over the asset's economic life

**cash-basis accounting** a method of accounting in which transactions are not recorded in the financial statements until there is an exchange of cash

**credit** a record of financial information on the right side of an account

**debit** a record of financial information on the left side of each account

**depreciation** the process of allocating the costs of a tangible asset over the asset's economic life

**double-entry accounting** an accounting method that requires the sum of the debits to equal the sum of the credits for each transaction
**expense** a cost associated with providing goods or services
**expense recognition** (also, matching principle) matches expenses with associated revenues in the period in which the revenues were generated
**gains** increases in organizational value from activities that are "incidental or peripheral" to the primary purpose of the business
**income statement** a financial statement that measures the organization's financial performance for a given period of time
**long-term asset** asset used in the normal, ongoing course of business for more than one year that is not intended to be resold
**losses** decreases in organizational value from activities that are "incidental or peripheral" to the primary purpose of the business
**net income** income earned when revenues and gains are greater than expenses and losses
**revenue** inflows or other enhancements of assets of an entity or settlements of its liabilities (or a combination of both) from delivering or producing goods, rendering services, or other activities that constitute the entity's ongoing major or central operations
**revenue recognition** principle stating that a company must recognize revenue in the period in which it is earned; it is not considered earned until a product or service has been provided
**T-account** a graphic representation of a general ledger account in which each account is visually split into left and right sides
**tangible asset** an asset that has physical substance

## Multiple Choice

1. Which method of accounting must be used by publicly traded companies?
   **a.** cash basis
   **b.** accrual basis
   **c.** a hybrid of cash and accrual basis
   **d.** modified accelerated basis

2. Which two accounting principles directly support the accrual method of accounting?
   **a.** periodicity, transparency
   **b.** historical cost, time period
   **c.** conservativism, going concern
   **d.** expense recognition, revenue recognition

3. Which of the following account types has a normal debit balance?
   **a.** cash
   **b.** notes payable
   **c.** wages payable
   **d.** revenue

4. Sara sells $100 worth of inventory to her client on credit on January 15. She delivers the inventory to the client on January 20. The client pays for the inventory of February 26. On what date should Sara recognize the revenue from the sale?
   **a.** January 15
   **b.** January 20
   **c.** January 31
   **d.** February 26

5. How is the book value of a fixed asset calculated?

**a.** original cost less accumulated depreciation
**b.** original cost divided by useful life
**c.** market value less depreciation expense
**d.** depreciable base less market value

6. Which of the following balance sheet item is classified as a fixed asset?
**a.** inventory
**b.** goodwill
**c.** equipment
**d.** accounts receivable

7. What is the formula to determine net income or net loss?
**a.** revenues less expenses
**b.** cash less expenses
**c.** revenues plus cash
**d.** revenues divided by expenses

## Review Questions

1. Joe runs a small barbershop. Most of his customers pay with cash. He has only a few monthly expenses including wages for one employee and utilities. Which method of accounting should Joe use?
2. Which method of accounting generally provides the most accurate information on organizational performance (income or loss)?
3. Under the accrual basis of accounting, when is an expense recorded?
4. Describe the basic elements of a T-account.
5. What is double-entry accounting?
6. What is the expense recognition principle?
7. Why is ethics an important concept pertaining to revenue and expense recognition principles?
8. What is the revenue recognition principle?
9. What is the difference between a tangible and an intangible fixed asset? List common examples of each.
10. How is the cost of a fixed asset recorded and recognized over time?

## Problems

1. Padma's Pools Inc. paid $500 for office supplies. What was the impact of this transaction on Padma's cash flow?
2. Sally's BigBox Store issued 1,000 shares of common stock with par value of $10 each and market value of $16 each in exchange for a new building. What was the impact of this transaction on Sally's cash flow?
3. Jose sells $500 worth of merchandise to a client on June 1. He delivers the product and invoices the customer on June 10. The customer pays Jose on July 9. What is Jose's revenue for June and July, respectively, under the cash and accrual methods of accounting?
4. Jamal's Car Repair purchases a new piece of equipment with a 10-year useful life for $10,000. What is the impact to Jamal's net income in the year of purchase if he expenses the equipment? If he capitalizes it using straight-line depreciation?
5. Mariela's Shop had revenues of $10,000 and expenses of $6,000 and has cash on hand of $5,000. What is Mariela's net income or net loss?

# Video Activity

## Depreciation Basics! With Journal Entries

Access multimedia content (http://openstax.org/books/principles-finance/pages/4-video-activity)

1. In what ways do depreciation and capitalization impact the income statement? If you were an investor considering investing a large sum of money into a company, what questions would you ask or what accounts would you look at to assess the impact to their income statement specifically? How would the characteristics of capitalization affect your feelings toward investing in the company?
2. If a company spends a large sum of cash to invest in equipment or another fixed asset, resulting in a loss that year on the income statement if they expense it, have they really experienced a loss? Or have they simply traded one asset for another? How does this delineation relate to capitalizing an asset and spreading out the cost throughout its useful life? Do you feel the depreciation process is ethical? Or do you feel it hides the true cost of business from being fully transparent on the financial statements? Explain your answer.

## Difference between Cash Flow and Profit

Access multimedia content (http://openstax.org/books/principles-finance/pages/4-video-activity)

3. When a business incurs an expense (office supplies, utilities, or wages, for example), is their cash flow the same in both timing and amount as the expense they recognize?
4. What are the key components necessary to calculate profit or loss for a business? Are they the same elements necessary to calculate cash flow?

5

# Financial Statements

**Figure 5.1** Financial statements are needed to understand a firm's financial position and performance. (credit: modification of work "Drowning by Numbers" by Jorge Franganillo/flickr, CC BY 2.0)

## Chapter Outline


**5.1** The Income Statement
**5.2** The Balance Sheet
**5.3** The Relationship between the Balance Sheet and the Income Statement
**5.4** The Statement of Owner's Equity
**5.5** The Statement of Cash Flows
**5.6** Operating Cash Flow and Free Cash Flow to the Firm (FCFF)
**5.7** Common-Size Statements
**5.8** Reporting Financial Activity


## Why It Matters

People say that accounting is the "language of business." Using the language of business, accountants are able to communicate the financial performance and health of a firm via four key financial statements. These statements are the income statement, balance sheet, statement of owner's equity, and statement of cash flows. Each statement provides different insights into a firm's performance and financial health. Though some users may favor one or two statements over another, they are best used together to get a full picture.

In this chapter, you'll be introduced to a firm called Clear Lake Sporting Goods. Clear Lake Sporting Goods is a small merchandising company (a company that buys finished goods and sells them to consumers) that sells hunting and fishing gear. It needs financial statements to understand its profitability and current financial position, manage cash flow, and communicate its finances to outside parties like investors, governing bodies, and lenders. We will walk through each financial statement, its components, how they are connected, and how financial statement users understand each one.

# 5.1 The Income Statement

## Learning Outcomes

By the end of this section, you will be able to:

- Outline the purpose and importance of the income statement.
- Identify the structure and key elements of the income statement.
- Discuss the use of EBITDA as a measure of a company's profit.

Financial information flows from one financial statement to the next. Thus, the statements are prepared in a specific order. The first statement prepared is the income statement.

## Functionality of the Income Statement

The **income statement** shows a firm's performance over a specific period of time. The statement helps financial statement users understand the sales generated during the period and the **expenses** incurred to generate those sales. If the expenses are smaller than the sales, the net result is profitability, or net income, rather than a net **loss**.

Breaking the income statement down into smaller pieces provides a more transparent view of the firm's performance, allowing users to see more clearly what areas of the business incurred expenses. This is helpful to management in driving improvements and to outside users in assessing performance.

## Sales and Gross Profit

The first section of the income statement begins with sales. Though financial statements are required to follow a certain format, account names can differ slightly from one firm to another. You may see the first line, often referred to as *the top line*, called *sales*, *sales revenue*, ***revenue***, *service revenues*, and other similar titles. All of these titles are meant to reflect the sales generated by selling product to customers in the day-to-day business. On Clear Lake's income statement in Figure 5.2, we see its top line referred to as Sales.

Income from items that aren't common to the firm's day-to-day business are reported as **gains** and losses, and they are reported further down in the income statement rather than at the top line with its regular, core business activities. This is to ensure that anomalies like selling a machine or a loss on retiring a bond don't mislead financial statement users as to the general performance of the firm and impact their assumptions of future results.

Firms report their sales and any reductions to sales separately on the income statement. They begin with gross sales, which includes all sales to customers. Clear Lake reported gross sales of $105,000 last year and $126,000 this year. The next line is sales returns and allowances, which is deducted from gross sales in order to find net sales. Clear Lake's sales returns and allowances were $5,000 and $6,000 respectively, leaving the company with net sales of $100,000 and $120,000 respectively

$$(\$105{,}000 - \$5{,}000 \text{ and } \$126{,}000 - \$6{,}000)\,. \tag{5.1}$$

Next, the cost of goods sold (COGS) is deducted from net sales in order to arrive at gross profit. (It is customary to refer to sales minus COGS as gross profit because gross margin = gross profit/sales.) Cost of goods sold includes the costs directly involved in making the product that was sold during the period. Common examples of costs included in cost of goods sold include direct labor, direct materials, and the overhead assigned to the product in production. For a service business, this would include its direct labor and any materials used to deliver its services. For a retail firm like Clear Lake Sporting Goods, this would include the costs of all the goods it purchased for resale. Clear Lake's COGS is seen at $50,000 and $60,000 for the prior and current years. Note that different types of companies will have different types of costs deducted in their Cost of Goods section. Clear Lake Sporting Goods is a retailer, or merchandiser that buys good to resell. Their cost of goods includes the cost of goods they purchased to resell. In the link to learning, you will explore Apple, a technology manufacturer. Their cost of goods would include the cost to manufacture the goods they sell. Another type of

firm is a service firm. A law office, for example, would include primarily the cost of labor in their cost of services.

Gross profit is a reflection of how profitable the firm's performance was in its core business function. It includes only the core business and direct costs of performing that business. If the company were a shoe company, gross profit would show how profitable the company was in simply making the shoes it sold. If it were a bakery, gross profit would show how profitable the company was in simply baking the goods it sold. Gross profit shows financial statement users how effective the business is at generating top-line profits on their core business function. It does not reflect the performance of other areas of the firm such as other operating costs to support the direct production process, indirect costs, and financing.

For Clear Lake Sporting Goods, we see its gross profit in Figure 5.2. The company earned $50,000 of gross profit ($\$100{,}000 - \$50{,}000$) the prior year and $60,000 in the current year ($\$120{,}000 - \$60{,}000$).

**Clear Lake Sporting Goods**
**Comparative Year-End Income Statements**

| | Prior Year | Current Year |
|---|---|---|
| Gross Sales | $105,000 | $126,000 |
| Sales Returns & Allowances | 5,000 | 6,000 |
| Net Sales | 100,000 | 120,000 |
| Cost of Goods Sold | 50,000 | 60,000 |
| Gross Profit | $ 50,000 | $ 60,000 |

**Figure 5.2 Income Statement through Gross Profit Line**

LINK TO LEARNING

Gross Profit

Visit the Apple, Inc. Annual Report (https://openstax.org/r/2020-doc-financial-annual-report) for 2020 and locate the income statement (it begins on page 31). Review gross sales, sales returns and allowances, and net sales for the last few years. What can you learn about the company's recent performance in the area of sales? Is the gross sales line improving? How about the sales returns and allowances line? Has it improved or declined or simply changed incrementally with gross sales?

Review the firm's gross profit for the past few years. Has it improved or declined? Consider the company's improvement (or decline) in gross sales as compared to the improvement or decline in gross profit. Does it reflect any change in performance over time (earning more or less gross profit on its gross sales)?

## Income from Operations

Gross profit is a very helpful measure, but it is only the first of several provided by the income statement. After gross profit is calculated, other operating expenses are deducted in order to calculate the firm's income from operations, also commonly called operating income. Common operating costs found in this section include building rent and utilities, property taxes, wages and salaries, and other overhead costs. In Figure 5.3, we can see Clear Lake's operating expenses. To sell its hunting and fishing equipment in the current year, Clear Lake Sporting Goods paid rent for its building ($5,500) and utilities for its retail and warehouse spaces ($2,500); recorded **depreciation** on equipment, buildings, and store furnishings (shelves, racks, etc.) ($3,600); and paid salaries to its indirect employees in accounting, purchasing, and human resources ($5,400). The company's operating expenses are deducted from gross profit to arrive at operating income

$$(\$60{,}000 - 5{,}500 - 3{,}600 - 5{,}400 - 2{,}500 = \$43{,}000)\,. \tag{5.2}$$

While gross profit reflects only how profitable the firm was in making its core product, operating income

reflects how profitable the firm's daily operations were as a whole. This still does not include other miscellaneous items outside the scope of a firm's normal business. Just as the name implies, it shows income from the core operations of the firm.

**Clear Lake Sporting Goods**
**Comparative Year-End Income Statements**

| | Prior Year | Current Year |
|---|---|---|
| Gross Sales | $105,000 | $126,000 |
| Sales Returns & Allowances | 5,000 | 6,000 |
| Net Sales | 100,000 | 120,000 |
| Cost of Goods Sold | 50,000 | 60,000 |
| Gross Profit | 50,000 | 60,000 |
| Rent Expense | 5,000 | 5,500 |
| Depreciation Expense | 2,500 | 3,600 |
| Salaries Expense | 3,000 | 5,400 |
| Utility Expense | 1,500 | 2,500 |
| Operating Income | $ 38,000 | $ 43,000 |

**Figure 5.3 Income Statement through Income from Operations**

We can see that the company was able to generate $\$20{,}000$ ($\$120{,}000 - \$100{,}000$) more in net sales in the current year than the prior year. However, it only generated $\$10{,}000$ ($\$60{,}000 - \$50{,}000$) in gross profit and $\$5{,}000$ ($\$43{,}000 - \$38{,}000$) of additional operating income. Further investigation shows that while net sales increased, so did the direct costs of its goods (COGS) and its operating expenses.

We will further explore how to assess each of these expenses later in the chapter using common-size analysis. Common-size analysis reflects each element of a financial statement as a percentage of the base. In the case of the income statement, the base is net sales. Here we would see that COGS was 50 percent of net sales in both the current ($\$60{,}000/\$120{,}000$) and prior year ($\$50{,}000/\$100{,}000$), indicating there wasn't any significant change in performance we could detect from the information provided in the income statement.

LINK TO LEARNING

### Operating Expenses

Visit the Apple, Inc. Annual Report (https://openstax.org/r/2020-doc-financial-annual-report) for 2020 and locate the company's income statement (the income statement begins on page 31). Review Apple's operating income for the last few years. Has it improved or declined? Does this fall in line with your expectations based on your previous review of the company's net sales and gross profit?

Based on the improvement or decline in operating income, review Apple's operating expenses to investigate. Have any of the operating expenses changed significantly? How did that impact the company's operating income? What might it tell you about the company's performance?

## Net Income

Finally, we move on to **net income**, or what is commonly referred to as *the bottom line*. Net income (or loss) reflects the net impact of all financial transactions for the firm, including those that are caused by events outside the normal course of business. The most common items deducted from operating income to arrive at net income include interest expense, gains/losses, and income tax expense. Remember, gains and losses are those that result from unusual transactions outside the normal course of business. Examples include selling a piece of old equipment or a loss on retiring debt.

We can see in Figure 5.4 that Clear Lake Sporting Goods has outstanding debt, so it incurred interest expense

of $2,000 in the current year and $3,000 the prior year. Since it recorded net income (not a loss), it must also record income tax expense of $6,000 in the current and $5,000 in the prior year.

**Clear Lake Sporting Goods**
**Comparative Year-End Income Statements**

| | Prior Year | Current Year |
|---|---|---|
| Gross Sales | $105,000 | $126,000 |
| Sales Returns & Allowances | 5,000 | 6,000 |
| Net Sales | 100,000 | 120,000 |
| Cost of Goods Sold | 50,000 | 60,000 |
| Gross Profit | 50,000 | 60,000 |
| Rent Expense | 5,000 | 5,500 |
| Depreciation Expense | 2,500 | 3,600 |
| Salaries Expense | 3,000 | 5,400 |
| Utility Expense | 1,500 | 2,500 |
| Operating Income | 38,000 | 43,000 |
| Interest Expense | 3,000 | 2,000 |
| Income Tax Expense | 5,000 | 6,000 |
| Net Income | $ 30,000 | $ 35,000 |

**Figure 5.4 Comparative Year-End Income Statement**

## EBITDA (Earnings before Interest, Taxes, Depreciation, and Amortization)

Now that we have a full income statement, we can look at another commonly used measure of financial performance called EBITDA. EBITDA stands for earnings before interest, taxes, depreciation, and amortization. Amortization is similar to depreciation. It is the spreading of the cost of an intangible asset over the course of its useful life. Intangible assets are long-term assets that lack physical substance, such as patents and copyrights.

Since EBITDA removes the effects of noncash items from the net income equation, it is considered a useful measure in assessing the cash flows provided by operating activities. We will assess cash flows using the **statement of cash flows** and various other cash flow measures later in this chapter as well.

As shown in Figure 5.5, Clear Lake Sporting Goods' EBITDA in the prior year was

$$\text{EBITDA} = \text{Net Income} + \text{Interest} + \text{Taxes} + \text{Depreciation} + \text{Amortization}$$
$$\$40{,}500 = (\$30{,}000 + \$3{,}000 + \$5{,}000 + \$2{,}500) \quad \textbf{5.3}$$

and in the current year was

$$\$46{,}600 = (\$35{,}000 + \$2{,}000 + \$6{,}000 + \$3{,}600). \quad \textbf{5.4}$$

| Clear Lake Sporting Goods<br>Comparative Year-End Income Statements | | |
|---|---|---|
| | **Prior Year** | **Current Year** |
| Gross Sales | $105,000 | $126,000 |
| Sales Returns & Allowances | 5,000 | 6,000 |
| Net Sales | 100,000 | 120,000 |
| Cost of Goods Sold | 50,000 | 60,000 |
| Gross Profit | 50,000 | 60,000 |
| Rent Expense | 5,000 | 5,500 |
| Depreciation Expense | 2,500 | 3,600 |
| Salaries Expense | 3,000 | 5,400 |
| Utility Expense | 1,500 | 2,500 |
| Operating Income | 38,000 | 43,000 |
| Interest Expense | 3,000 | 2,000 |
| Income Tax Expense | 5,000 | 6,000 |
| Net Income | $ 30,000 | $ 35,000 |

**Figure 5.5 EBITDA (Earnings before Interest, Taxes, Depreciation, and Amortization)**

THINK IT THROUGH

### Net Income

Visit the Apple, Inc. Annual Report (https://openstax.org/r/2020-doc-financial-annual-report) for 2020 and locate the company's income statement (the income statement begins on page 31). Review net income for the last few years. Has it improved or declined? Does this fall in line with your expectations based on your previous review of the company's operating income?

**Solution:**

Net income improved in the current year over last year but declined from 2018 to 2019 (from $59,531 to $55,256). Apple's EBITDA in 2020 was 108.89. (Amounts are in millions.)

# 5.2 The Balance Sheet

## Learning Outcomes

By the end of this section, you will be able to:

- Outline the purpose and importance of the balance sheet.
- Identify the structure and key elements of the balance sheet.

## The Accounting Equation and the Classified Balance Sheet

Recall that the income statement shows the performance of a firm over the course of time. The classified balance sheet shows the financial state of a company as of a specific point in time. It is a key distinction between the two statements. The classified balance sheet is prepared in sections that align with the accounting equation.

Remember, the **accounting equation** reflects the **assets** (items owned by the organization) and how they were obtained (by incurring **liabilities** or provided by owners). Liabilities are debts owed to other parties. Stated differently, every asset has a claim against it—by creditors and/or owners.

$$\text{Assets} = \text{Liabilities} + \text{Owner's Equity} \quad \textbf{5.5}$$

The classified balance sheet is thus broken down into three sections; assets, liabilities, and owner's equity. If prepared correctly, the total assets on the balance sheet equals the total liabilities and owner's equity sections

of the balance sheet.

The classified balance sheet is considered or termed *classified* when the assets and liabilities within the balance sheet are grouped into even smaller sections: current and noncurrent (see Figure 5.6). Both assets and liabilities are broken down on the balance sheet into current and noncurrent classifications in order to provide more detail and transparency as well as abide by the convention of reporting in descending order of liquidity. **Current assets** are those that can be used or converted to cash within a year. Common examples of current assets include cash, inventory, accounts receivable, and short-term investments. Assets that will be in use longer than a year are considered noncurrent. Common examples of **noncurrent assets** include notes receivable, machinery and equipment, buildings, and land.

Just as we noted a few key differences in the income statements based on the type of firm, you may also notice a few slight differences in the balance sheet depending on the firm type. Clear Lake Sporting Goods is a retailer. Thus, you will see that their inventory for resale on their balance sheet is simply called "Inventory." This is the goods they have purchased for resale but have not yet sold. A manufacturer, like Apple, Inc. in the Link to Learning sections, will have a variety of inventory types including raw materials, work in progress, and finished goods inventory. These represent the various states of the inventory (ready to use, partially complete, and fully completed product). A service firm, on the other hand, may not have inventory at all. If it does, it may be simple goods it uses to help deliver its service. For example, a cleaning company may keep an inventory of cleaning supplies.

**Figure 5.6 Graphical Representation of the Accounting Equation** Both assets and liabilities are categorized as current and noncurrent.

Clear Lake Sporting Goods has cash, accounts receivable, inventory, short-term investments, and equipment. It rents its facilities, so it has no buildings on its balance sheets. Of all its assets, only the equipment is long term. The assets section for Clear Lake's classified balance sheet is shown in Figure 5.7.

**Clear Lake Sporting Goods**
**Comparative Year-End Balance Sheets**

| | Prior Year | Current Year |
|---|---|---|
| **Assets** | | |
| **Current Assets:** | | |
| Cash | $ 90,000 | $110,000 |
| Accounts Receivable | 20,000 | 30,000 |
| Inventory | 35,000 | 40,000 |
| Short-Term Investments | 15,000 | 20,000 |
| **Total Current Assets** | 160,000 | 200,000 |
| **Noncurrent Assets:** | | |
| Equipment | 40,000 | 50,000 |
| **Total Assets** | $200,000 | $250,000 |

**Figure 5.7 Assets Section of Classified Balance Sheet**

## THINK IT THROUGH

### Current and Noncurrent Assets

Visit the Apple, Inc. Annual Report (https://openstax.org/r/2020-doc-financial-annual-report) for 2020 and locate the company's balance sheet (the balance sheet begins on page 33). What types of current assets does the company have? What types of noncurrent assets does it have? How has the total of each type of

asset changed over time?

**Solution:**

Apple reports cash and cash equivalents, marketable securities, accounts receivable, inventories, vendor non-trade receivables, and "other" current assets on its balance sheet. The company's current assets decreased from $162,819 in 2019 to $143,713 in 2020. Apple reports marketable securities, property, plant and equipment, and other noncurrent assets in the noncurrent asset section of its balance sheet. The company's noncurrent assets increased from $175,697 in 2019 to $180,175 in 2020. (Amounts are in millions.)

We've covered the assets side of the accounting equation; now let's turn our attention to the other side of the equation and the other two sections of the balance sheet: liabilities and equity. Just like the assets section, the liabilities section is broken down between current and noncurrent. **Current liabilities** are those that will be due within a year. Common examples of current liabilities include accounts payable, wages payable, and unearned revenue. **Noncurrent liabilities** are those that are due more than a year into the future. Notes payable is a common noncurrent liability.

Clear Lake Sporting Goods has accounts payable and has collected payments from a few customers that it hasn't yet shipped its product to (unearned revenue). It also owes money on a note payable. Its accounts payable and unearned revenue are both current liabilities. The note payable is not due for several years, thus making it a noncurrent liability (see Figure 5.8).

| | Prior Year | Current Year |
|---|---|---|
| **Current Liabilities:** | | |
| Accounts Payable | $ 60,000 | $ 75,000 |
| Unearned Revenue | 10,000 | 25,000 |
| **Total Current Liabilities** | 70,000 | 100,000 |
| **Noncurrent Liabilities:** | | |
| Notes Payable | 40,000 | 50,000 |
| **Total Liabilities** | $110,000 | $150,000 |

**Figure 5.8 Liability Section of Classified Balance Sheet**

## THINK IT THROUGH

### Current and Noncurrent Liabilities

Visit the Apple, Inc. Annual Report (https://openstax.org/r/2020-doc-financial-annual-report) for 2020 and locate its balance sheet (the balance sheet begins on page 33). What types of current and noncurrent liabilities does the company have? How has the total of each type of liability changed over time?

**Solution:**

Apple has accounts payable, deferred revenue, commercial paper, and term debt listed as current liabilities. Its current liabilities declined by only a small amount from 2019 to 2020 ($105,718 to $105,392).

The company has term debt and "other" listed as noncurrent liabilities, which increased from 2019 to 2020 ($142,310 to $153,157). (Amounts are in millions.)

The stockholders' equity section of the balance sheet for corporations contains two primary categories of accounts. The first is contributed capital, which is funds paid in by owners. The second category is earned capital, which is funds earned by the corporation as part of business operations. On the balance sheet,

**retained earnings** is a key component of the earned capital section, while the stock accounts such as common stock, preferred stock, and additional paid-in capital are the primary components of the contributed capital section.

Clear Lake Sporting Goods has just one contributed capital account—common stock—and one earned capital account—retained earnings. The equity section of its balance sheet is shown in Figure 5.9.

| | Prior Year | Current Year |
|---|---|---|
| **Stockholder Equity** | | |
| Common Stock | $ 75,000 | $ 80,000 |
| Ending Retained Earnings | 15,000 | 20,000 |
| Total Stockholders' Equity | 90,000 | 100,000 |
| **Total Liabilities and Stockholder Equity** | $200,000 | $250,000 |

**Figure 5.9 Stockholders' Equity Section of Classified Balance Sheet**

THINK IT THROUGH

### Assets, Liability, and Equity

Visit the Apple, Inc. Annual Report (https://openstax.org/r/2020-doc-financial-annual-report) for 2020 and locate the company's balance sheet (the balance sheet begins on page 33). What is the amount of the company's total assets for the most recent year? What is the amount of its total liabilities and equity?

**Solution:**

Apple's total assets for 2020 were $323,888, and its total liabilities and equity were also $323,888. (Amounts are in millions.)

## Importance of the Balance Sheet

Now that we have gone to all the work to carefully assemble a classified balance sheet, what do we use it for? The answer lies within the accounting equation itself. Think of the accounting equation from a "sources and claims" perspective. Under this approach, the assets (items owned by the organization) were obtained by incurring liabilities or were provided by owners. Stated differently, every asset has a claim against it—by creditors and/or owners. The balance sheet shows us what the firm has (its assets), who owns them (equity), and who the firm owes (its liabilities).

## Limitations of the Balance Sheet

The balance sheet is indeed a very helpful financial statement, but it also poses challenges. First, assets on the balance sheet, under generally accepted accounting principles (GAAP), are recorded at historical cost. Historical cost is simply the cost paid for the item at the time it was purchased. Changes in market value of big-ticket items like land or buildings are not reflected in the balance sheet. Land remains at historical cost, and depreciable items like buildings are reflected at their current book value (historical cost less accumulated depreciation). If the asset has appreciated over time, the higher market value of the assets would not be seen on the balance sheet.

Estimates are another limitation of the balance sheet. Items on the balance sheet such as allowance for doubtful accounts and allowance for bad debt are based on estimates. The useful lives for calculating depreciation is another common estimate. If these estimates are incorrect, the net value of the asset can be under- or overstated.

Another key limitation is the fact that a balance sheet reflects balances at only one given point in time. This means that the account value could have been quite different on the day before or the day after the date of the balance sheet. For example, if a firm were concerned with certain ratios or investor/lender expectations of

its cash balance, it could choose to not pay several vendor payments in the last week of December. Thus, on December 31, the firm reflects a high cash balance on its balance sheet. However, by the end of the first week of January, it has caught up on late vendor payments and again shows a low cash balance.

Finally, there are many possible things of value that are not recorded on the balance sheet. Internally generated assets and the firm's human capital are two common examples. Internally generated assets can be anything from a website, a process, to an idea.

# 5.3 The Relationship between the Balance Sheet and the Income Statement

## Learning Outcomes

By the end of this section, you will be able to:

- Identify connected elements between the balance sheet and the income statement.
- Differentiate between expenses and payables.

## Net Income and Retained Earnings

As mentioned earlier, the financial statements are linked by certain elements and thus must be prepared in a certain order. The income statement was first since net income (or loss) is a required figure in preparing the balance sheet. During the period close process, all temporary accounts are closed to the income summary account, which is then closed to retained earnings. All revenue and expense accounts are closed since they are temporary. The net result is either net profit or net loss as the balance in the income summary account.

Remember that the retained earnings account reflects all income the firm has earned since its inception less any **dividends** paid out to shareholders. Thus the result (net income) of the income statement feeds the retained earnings account on the balance sheet. Retained earnings is also an element of the statement of stockholders' equity, which we will cover later in this chapter.

In Figure 5.10, we see net income in the current year of $35,000, which was added to the company's prior year retained earnings balance of $15,000. Notice, however, that the prior year balance was $15,000, and the current year balance is only $20,000. It does not total $50,000 as we might have expected.

Remember, retained earnings represents all earnings since inception less any dividends paid out. Clear Lake Sporting Goods must have paid out $30,000 in dividends in the current year. We will see this information laid out in the statement of retained earnings. In the prior year they began with a $10,000 balance in retained earnings. Income of $30,000 increased retained earnings and dividends paid back out to investors reduced retained earnings, leaving an ending balance in the prior year of $15,000. This rolls over and is the beginning balance for the current year. In the current year Clear Lake had net income of $35,000 and paid $30,000 of their earnings out to shareholders, essentially resulting in a $5,000 increase to the retained earnings account.

**Clear Lake Sporting Goods**
**Statement of Retained Earnings**

| | Prior Year | Current Year |
|---|---|---|
| Beginning Retained Earnings Balance Jan 1 | $10,000 | $15,000 |
| Plus Net Income | 30,000 | 35,000 |
| Less Dividends Paid to Shareholders | 25,000 | 30,000 |
| Ending Retained Earnings Dec 31 | $15,000 | $20,000 |

**Figure 5.10 Statement of Retained Earnings**

Now we can see the full flow of information from the income statement to the statement of retained earnings (Figure 5.10) and finally to the balance sheet. Clear Lake's net income flows from the income statement into retained earnings, which is reflected on the statement of retained earnings. The balance in retained earnings is then reflected on the balance sheet. This flow is depicted in Figure 5.11.

**Clear Lake Sporting Goods**
**Comparative Year-End Income Statements**

| | Prior Year | Current Year |
|---|---|---|
| Gross Sales | $105,000 | $126,000 |
| Sales Returns & Allowances | 5,000 | 6,000 |
| Net Sales | 100,000 | 120,000 |
| Cost of Goods Sold | 50,000 | 60,000 |
| Gross Margin | 50,000 | 60,000 |
| Rent Expense | 5,000 | 5,500 |
| Depreciation Expense | 2,500 | 3,600 |
| Salaries Expense | 3,000 | 5,400 |
| Utility Expense | 1,500 | 2,500 |
| Operating Income | 38,000 | 43,000 |
| Interest Expense | 3,000 | 2,000 |
| Income Tax Expense | 5,000 | 6,000 |
| Net Income | $ 30,000 | $ 35,000 |

**Clear Lake Sporting Goods**
**Comparative Year-End Balance Sheets**

| | Prior Year | Current Year |
|---|---|---|
| **Assets** | | |
| **Current Assets:** | | |
| Cash | $ 90,000 | $110,000 |
| Accounts Receivable | 20,000 | 30,000 |
| Inventory | 35,000 | 40,000 |
| Short-Term Investments | 15,000 | 20,000 |
| **Total Current Assets** | 160,000 | 200,000 |
| Noncurrent Assets: | | |
| Equipment | 40,000 | 50,000 |
| **Total Assets** | 200,000 | 250,000 |
| **Current Liabilities:** | | |
| Accounts Payable | 60,000 | 75,000 |
| Unearned Revenue | 10,000 | 25,000 |
| **Total Current Liabilities** | 70,000 | 100,000 |
| **Noncurrent Liabilities:** | | |
| Notes Payable | 40,000 | 50,000 |
| **Total Liabilities** | 110,000 | 150,000 |
| **Stockholder Equity** | | |
| Common Stock | 75,000 | 80,000 |
| Ending Retained Earnings | 15,000 | 20,000 |
| Total Stockholders' Equity | 90,000 | 100,000 |
| **Total Liabilities and Stockholder Equity** | $200,000 | $250,000 |

**Clear Lake Sporting Goods**
**Statement of Retained Earnings**

| | Prior Year | Current Year |
|---|---|---|
| Beginning Retained Earnings Balance Jan 1 | $10,000 | $15,000 |
| Plus Net Income | 30,000 | 35,000 |
| Less Dividends Paid to Shareholders | 25,000 | 30,000 |
| Ending Retained Earnings Dec 31 | $15,000 | $20,000 |

**Figure 5.11 Connections between Clear Lake Sporting Goods' Balance Sheet and Income Statement**

LINK TO LEARNING

### Apple's Income Statement and Balance Sheet

Visit the Apple, Inc. Annual Report (https://openstax.org/r/2020-doc-financial-annual-report) for 2020 and locate the company's income statement and balance sheet (they begin on page 31). What is the company's net income for the most recent year? What is the amount of retained earnings on the balance sheet for the current and prior years? Does it appear the company paid out dividends this year?

## Expenses versus Payables

There is another key relationship between the income statement and the balance sheet can often be confusing to non-accountants: an expense versus a payable. The two are often assumed to be the same thing. However,

it is important to note that the two are distinctly different.

Let's look at an example to outline the key differences. Clear Lake Sporting Goods incurred utility expenses during the current period (electric and gas). Its utilities totaled $1,500. In the month that followed, the utilities vendor sent an invoice for $1,500. Clear Lake has incurred an expense. It will reflect an expense of $1,500 on the income statement for the utilities expense. This is the income statement impact of the transaction. So is it safe to assume that because Clear Lake has an expense, it also used cash? Not necessarily. Or is it safe to assume that if the company has an expense, it is the same as a payable? Again, the answer is no.

Remember, the accounting equation rests on the foundation of the double-entry accounting system. This means that every transaction has two sides: a debit and a credit. They must be equal. When Clear Lake records an expense of $1,500, it must also record the other half of that transaction. In this case, the company incurred utilities expenses throughout the period "on account," which means it records an increase in their accounts payable. When the invoice comes due, another transaction must then be recorded to reduce accounts payable and reduce cash. Accounts payable is a liability found on the balance sheet, normally a current liability. The expense incurred caused the payable, but it is distinctly separate from the payable (see Figure 5.12).

**Clear Lake Sporting Goods**
**Comparative Year-End Income Statements**

| | Prior Year | Current Year |
|---|---|---|
| Gross Sales | $105,000 | $126,000 |
| Sales Returns & Allowances | 5,000 | 6,000 |
| Net Sales | 100,000 | 120,000 |
| Cost of Goods Sold | 50,000 | 60,000 |
| Gross Profit | 50,000 | 60,000 |
| Rent Expense | 5,000 | 5,500 |
| Depreciation Expense | 2,500 | 3,600 |
| Salaries Expense | 3,000 | 5,400 |
| Utility Expense | 1,500 | 2,500 |
| Operating Income | 38,000 | 43,000 |
| Interest Expense | 3,000 | 2,000 |
| Income Tax Expense | 5,000 | 6,000 |
| Net Income | $ 30,000 | $ 35,000 |

**Clear Lake Sporting Goods**
**Comparative Year-End Balance Sheets**

| | Prior Year | Current Year |
|---|---|---|
| **Assets** | | |
| **Current Assets:** | | |
| Cash | $ 90,000 | $110,000 |
| Accounts Receivable | 20,000 | 30,000 |
| Inventory | 35,000 | 40,000 |
| Short-Term Investments | 15,000 | 20,000 |
| **Total Current Assets** | 160,000 | 200,000 |
| Equipment | 40,000 | 50,000 |
| **Total Assets** | 200,000 | 250,000 |
| **Current Liabilities:** | | |
| Accounts Payable | 60,000 | 75,000 |
| Unearned Revenue | 10,000 | 25,000 |
| **Total Current Liabilities** | 70,000 | 100,000 |
| **Noncurrent Liabilities:** | | |
| Notes Payable | 40,000 | 50,000 |
| **Total Liabilities** | 110,000 | 150,000 |
| **Stockholder Equity** | | |
| Common Stock | 75,000 | 80,000 |
| Ending Retained Earnings | 15,000 | 20,000 |
| Total Stockholders' Equity | 90,000 | 100,000 |
| **Total Liabilities and Stockholder Equity** | $200,000 | $250,000 |

**Figure 5.12 Connections between Expenses and Accounts Payable**

## 5.4 The Statement of Owner's Equity

### Learning Outcomes

By the end of this section, you will be able to:

- Explain the concept of owner's equity.
- Outline the purpose and importance of the statement of owner's equity.
- Identify the structure and key elements of the statement of owner's equity.

## What Is Equity?

Recall that the accounting equation can help us see what is owned (assets), who is owed (liabilities), and finally who the owners are (equity). The statement of owner's equity addresses the last segment of the accounting equation in detail by laying out the equity elements of the firm and highlighting changes in these elements throughout the period.

Equity represents the ownership of the firm. The stockholders' equity section of the balance sheet for corporations contains two primary categories of accounts. The first is paid-in capital or contributed capital—consisting of amounts paid in by owners. The second category is earned capital, consisting of amounts earned by the corporation as part of business operations. On the balance sheet, retained earnings is a key component of the earned capital section, while the stock accounts such as common stock, preferred stock, and additional paid-in capital are the primary components of the contributed capital section.

Common stock represents ownership in the firm. Common stockholders normally have voting rights. Preferred stock has unique rights that are "preferred," or more advantageous, to shareholders than common stock. Unlike common stockholders, preferred shareholders typically do not have voting rights and do not share in the common stock dividend distributions. Instead, the "preferred" classification entitles shareholders to a dividend that is fixed (assuming sufficient dividends are declared). Treasury stock is shares that were outstanding and have been repurchased by the firm but not retired. Thus they are still issued, but not outstanding. Additional paid-in capital is the difference between the issue price and par value of the common stock. For example, if a firm issued and sold stock at a market price of $20 that had a $5 par value, $5 for each share would be recorded into common stock and the excess $15 per share would be recorded into the additional paid-in capital account.

If we review the balance sheet for Clear Lake Sporting Goods, we see just two elements of equity: common stock and retained earnings. Common stock in the prior year was $75,000 and increased to $80,000 in the current year, indicating Clear Lake issued additional common stock (see Figure 5.13).

**Clear Lake Sporting Goods**
**Comparative Year-End Balance Sheets**

| | Prior Year | Current Year |
|---|---|---|
| **Stockholder Equity** | | |
| Common Stock | $ 75,000 | $ 80,000 |
| Ending Retained Earnings | 15,000 | 20,000 |
| Total Stockholders' Equity | 90,000 | 100,000 |
| **Total Liabilities and Stockholder Equity** | $200,000 | $250,000 |

**Figure 5.13 Stockholder Equity Section of Balance Sheet**

### THINK IT THROUGH

#### Equity Accounts

Visit the Apple, Inc. Annual Report (https://openstax.org/r/2020-doc-financial-annual-report) for 2020 and locate the company's balance sheet (it begins on page 33). What types of equity accounts does it report?

**Solution:**

Apple reports common stock, retained earnings, and accumulated other comprehensive income.

## Distributions to Owners

When firms earn a profit, they have two options as to what to do with their earnings. They can keep (retain) them and reinvest them back into the business, or they can pay them out to their shareholders in the form of

dividends. Dividends are commonly in the form of cash, but dividends can be paid out in the form of stock or other assets as well.

To pay a cash dividend, the firm must have enough cash on hand and sufficient retained earnings. They cannot pay out a dividend beyond the retained earnings available. Some companies issue shares of stock as a dividend rather than cash or property. This often occurs when the company has insufficient cash but wants to keep its investors happy. When a company issues a stock dividend, it distributes additional shares of stock to existing shareholders.

A property dividend occurs when the firm pays out dividends in the form of something other than stock or cash, often one of their assets or something they hold in inventory. For example, Walt Disney Company may choose to distribute tickets to visit its theme parks. A property dividend may be declared when a company wants to reward its investors but doesn't have the cash to distribute, or if it needs to hold on to its existing cash for other investments.

Remember, the retained earnings account reflects the cumulative earnings of a firm since they began business, less dividends paid out to shareholders. This includes all forms of dividends (cash, stock, and other assets). Note that dividends are distributed or paid only to shares of stock that are outstanding. Treasury shares are not outstanding, so no dividends are declared or distributed for these shares. Regardless of the type of dividend, the declaration always causes a decrease in the retained earnings account.

THINK IT THROUGH

### Dividends

Visit the Apple, Inc. Annual Report (https://openstax.org/r/2020-doc-financial-annual-report) for 2020. Review the notes to the financial statements found on pages 19 and 20. What kind of dividends did the company pay (cash, property, stock)? Review the notes regarding dividends on page 26. What does Apple intend to do regarding dividends in the future, pending board approval?

**Solution:**

Apple issued cash dividends. On page 26, it notes that the company intends to increase the dividend annually, pending approval by the board.

## Elements of the Statement of Owner's Equity

Now that we have covered the basic elements of equity and know what dividends are, we have the basic pieces we need to create the statement of **owner's equity**. The statement is broken out into columns, one for each element of equity: common stock, preferred stock, additional paid-in capital, retained earnings, and treasury stock.

The first line of the statement provides the balance of each segment as of the first day of the period. Each following line provides information on any events during the period that changed the value of any of the accounts. Common examples of events found on the statement include net income or loss for the period, issuing common or preferred stock, purchasing or selling treasury stock, and declaring a dividend.

Clear Lake Sporting Goods has just common stock and retained earnings to report in their statement of owner's equity. They had just two events to report in their statement that impacted their equity accounts; they reported net income and they issued dividends (see Figure 5.14).

| | Common Stock | Additional Paid-in Capital | Retained Earnings | Treasury Stock | Total |
|---|---|---|---|---|---|
| Beginning Balance | $75,000 | $0 | $15,000 | $0 | $ 90,000 |
| Net Income | | | 35,000 | | 35,000 |
| Dividends Paid to Shareholders | | | (30,000) | | (30,000) |
| Common Stock Issued | 5,000 | | | | 5,000 |
| Ending Balance | $80,000 | $0 | $20,000 | $0 | $100,000 |

**Figure 5.14 Statement of Stockholder Equity for Clear Lake Sporting Goods**

LINK TO LEARNING

Cash Flows

Khan Academy (https://openstax.org/l/50CashFlowsVid) explains cash flows in a unique way.

# 5.5 The Statement of Cash Flows

## Learning Outcomes

By the end of this section, you will be able to:

- Outline the purpose and importance of the statement of cash flows.
- Identify the structure and key elements of the statement of cash flows.

The final financial statement is the statement of cash flows. It is a crucial statement, as it shows the sources of and uses of cash for the firm during the accounting period. Remember, under accrual accounting, transactions are recorded when they occur, not necessarily when cash moves. Thus, the income statement does not provide all the insights necessary to understand a firm's cash flows. To fully understand the firm's flow of cash, the statement of cash flows is needed.

## Importance of the Statement of Cash Flows

Remember, most firms use accrual accounting. Revenues and expenses are recorded when they occur, not necessarily when cash moves. This can create timing differences between profits and cash flows. A firm can be profitable and still not have an adequate flow of cash. The opposite is also true: it can experience a net loss and still have cash on hand. Earning a profit is wonderful, but it is not the only goal an organization has. It must also have adequate cash flow to support daily operations. To support cash planning and to provide external financial statement users such as lenders and investors information about the firm's cash flow, the statement of cash flows is prepared. Cash flow is also a crucial metric for determining the value of a company.

External financial statement users also rely on the statement of cash flows to help them evaluate the quality of the firm's earnings. Users compare earnings to cash flow to assess the validity of the earnings data. For example, a firm reporting a strong profit but very little cash flow might raise some questions as to what was recorded to drive profits that isn't also driving cash flows.

The statement of cash flows also helps external users determine the driving forces behind the firm's cash flows. They can see if cash is generated primarily by daily operations or if cash is being generated or consumed by events outside the firm's normal course of business.

There are two key methods of preparing the statement: direct and indirect. FASB (Financial Accounting Standards Board) favors the **direct method**. Despite that, the most common method used by far in general practice is the **indirect method**. The direct method lists cash flows directly from revenues and expenses, whereas the indirect method reconciles income to cash flows. The indirect method begins with net income and reconciles each account in order to arrive at net cash flow. It essentially reconciles **accrual basis** accounting to

**cash basis**, or cash flow.

## Operating Activities

To provide clear information about what areas of the business generated and used cash, the statement of cash flows is broken down into three key categories: operating, financing, and investing. The operating section reflects cash flows generated by and used by the day-to-day operations of the business. Investing activities include investments in other firms as well as investments in the firm itself (items like machinery, land, or other fixed assets). Finally, financing activities are those used to provide funds to run the business (loans, interest).

As mentioned, operating activities are those that are used or generated by the day-to-day operations of the firm. The operating activities section of the statement of cash flows begins with net income. All lines thereafter, in that section, are then adjustments to reconcile net income to actual cash flows by adding back **noncash expenses** like depreciation and adjusting for changes in asset and liability accounts. For example, depreciation is a noncash expense. Thus, depreciation is added back to net income.

To prepare the statement of cash flows for Clear Lake Sporting Goods, we need the beginning cash balance from the balance sheet, net income and depreciation expense from the income statement, and a set of comparative balance sheets to see the change in asset and liability accounts (see Figure 5.15).

**Clear Lake Sporting Goods**
**Comparative Year-End Income Statements**

| | Prior Year | Current Year |
|---|---|---|
| Gross Sales | $105,000 | $126,000 |
| Sales Returns & Allowances | 5,000 | 6,000 |
| Net Sales | 100,000 | 120,000 |
| Cost of Goods Sold | 50,000 | 60,000 |
| Gross Margin | 50,000 | 60,000 |
| Rent Expense | 5,000 | 5,500 |
| Depreciation Expense | 2,500 | 3,600 |
| Salaries Expense | 3,000 | 5,400 |
| Utility Expense | 1,500 | 2,500 |
| Operating Income | 38,000 | 43,000 |
| Interest Expense | 3,000 | 2,000 |
| Income Tax Expense | 5,000 | 6,000 |
| Net Income | $ 30,000 | $ 35,000 |

**Clear Lake Sporting Goods**
**Comparative Year-End Balance Sheets**

| | Prior Year | Current Year |
|---|---|---|
| **Assets** | | |
| **Current Assets:** | | |
| Cash | $ 90,000 | $110,000 |
| Accounts Receivable | 20,000 | 30,000 |
| Inventory | 35,000 | 40,000 |
| Short-Term Investments | 15,000 | 20,000 |
| **Total Current Assets** | 160,000 | 200,000 |
| Noncurrent Assets: | | |
| Equipment | 40,000 | 50,000 |
| **Total Assets** | 200,000 | 250,000 |
| **Current Liabilities:** | | |
| Accounts Payable | 60,000 | 75,000 |
| Unearned Revenue | 10,000 | 25,000 |
| **Total Current Liabilities** | 70,000 | 100,000 |
| **Noncurrent Liabilities:** | | |
| Notes Payable | 40,000 | 50,000 |
| **Total Liabilities** | 110,000 | 150,000 |
| **Stockholder Equity** | | |
| Common Stock | 75,000 | 80,000 |
| Ending Retained Earnings | 15,000 | 20,000 |
| Total Stockholders' Equity | 90,000 | 100,000 |
| **Total Liabilities and Stockholder Equity** | $200,000 | $250,000 |

**Figure 5.15 Comparative Income Statements and Balance Sheets**

Clear Lake's statement of cash flows begins with the current year net income of $35,000 from the income statement. Next, noncash expenses are deducted. Clear Lake's only noncash expense on their current year income statement is depreciation of $3,600. Since deprecation is an expense that reduces income but is not actually paid out in cash in the current period, it must be added back to net income to reconcile net income to cash flow.

Next, changes in operational assets and liabilities are used to continue reconciling net income to actual cash flow. For example, Clear Lake's accounts receivable increased from the prior period to the current period. This means that there were more sales recorded but not yet received in cash in this period than there were in the prior period, making an increase in accounts receivable a reduction on the statement. Inventory increased, which means additional cash was spent to acquire it, making it a use of cash or reduction to net income to move closer to cash. Accounts payable and unearned revenue, both liability accounts, increased. Since these are liabilities, an increase would indicate that the liability was incurred but not as quickly paid out; thus it is an increase to the statement.

Tallying all these adjustments to net income shows Clear Lake's net cash flows provided by operating activities of $53,600 (see Figure 5.16).

| Clear Lake Sporting Goods<br>Statement of Cash Flows<br>Indirect Method | | |
|---|---|---|
| Cash Flow from Operating Activities | | |
| Net Income | | $35,000 |
| Adjustment to Reconcile Net Income to Net Cash Flow from Operating Activities: | | |
| Depreciation | $ 3,600 | |
| Accounts Receivable Increase | (10,000) | |
| Inventory Increase | (5,000) | |
| Accounts Payable Increase | 15,000 | |
| Unearned Revenue Increase | 15,000 | 18,600 |
| Net Cash Flow from Operating Activities | | $53,600 |

**Figure 5.16 Operating Activities Section of the Statement of Cash Flows**

## Investing Activities

As mentioned, investing activities include investments in other firms as well as investments in the firm itself (items like machinery, land, or other fixed assets). These are items that are capitalized (placed on the balance sheet and depreciated over time) and thus did not reduce net income. They did, however, cause an impact to cash flow (see Figure 5.17).

During the current year, Clear Lake purchased an additional $5,000 in short-term investments (see the comparative balances sheets; the balance in that account increased by $5,000 since the prior year). They also purchased additional plant assets in the amount of $13,600. This amount can be figured by comparing the difference in the current and prior plant assets accounts and including the impact of current year depreciation ($50,000 current year balance less $40,000 prior year balance and $3,600 of depreciation = $13,600 of new assets purchased).

| | | |
|---|---|---|
| Cash Flow from Investing Activities | | |
| Purchase of Short-Term Investments | $(5,000) | |
| Cost of New Plant Assets | (13,600) | |
| Net Cash Flow: Investing Activities | | $(18,600) |

**Figure 5.17 Investing Activities Section of the Statement of Cash Flows**

## Financing Activities

Recall that financing activities are those used to provide funds to run the business. Common items in this section of the statement include the payment of dividends, issuance of common or preferred stock, and issuance or payment of notes payable (see Figure 5.18).

In the current year, Clear Lake took out additional notes payable (a cash inflow). We can see this by the increase in their notes payable account from the prior year to current year ($40,000 to $50,000). This is an inflow of cash and thus an increase on the statement. Dividends of $30,000 were paid to shareholders (found

on the statement of retained earnings and the statement of owner's equity). Finally, we see that Clear Lake must have issued additional common stock, as their common stock balance increased from $75,000 to $80,000.

| | | |
|---|---|---|
| Cash Flow from Financing Activities | | |
| Additional Notes Payable | $10,000 | |
| Issuance of Common Stock | 5,000 | |
| Payment of Dividends | (30,000) | |
| Net Cash Flow from Financing Activities | | $(15,000) |

**Figure 5.18 Financing Activities Section of the Statement of Cash Flows**

## LINK TO LEARNING

### Statement of Cash Flows

Visit the Apple, Inc. Annual Report (https://openstax.org/r/2020-doc-financial-annual-report) for 2020 and locate the company's statement of cash flows (it begins on page 35). What is the cash provided by/used by operating activities? Review the key adjustments in the operating section. What are the biggest adjustments? Review the investing section of the statement. Did the company have a net cash inflow or net cash used by investing? What key items appear in this section? What was the net cash provided by or used by financing activities? What key items appear in this section for Apple?

The final task to wrap up the statement of cash flows is to tally net cash generated or used by summing all three sections. This amount is then used to adjust the beginning cash balance from the balance sheet. Assuming the statement was prepared correctly, the sum should equal the ending cash balance on the balance sheet.

In the full statement, we can see that Clear Lake has net cash flow of $20,000. The beginning cash balance was $90,000, making the ending cash balance $110,000 (see Figure 5.19).

| Clear Lake Sporting Goods<br>Statement of Cash Flows<br>Indirect Method | | |
|---|---|---|
| Cash Flow from Operating Activities | | |
| Net Income | | $ 35,000 |
| Adjustment to Reconcile Net Income to Net Cash Flow from Operating Activities: | | |
| Depreciation | $ 3,600 | |
| Accounts Receivable Increase | (10,000) | |
| Inventory Increase | (5,000) | |
| Accounts Payable Increase | 15,000 | |
| Unearned Revenue Increase | 15,000 | 18,600 |
| Net Cash Flow from Operating Activities | | 53,600 |
| Cash Flow from Investing Activities | | |
| Purchase of Short-Term Investment | (5,000) | |
| Cost of New Plant Assets | (13,600) | |
| Net Cash Flow: Investing Activities | | (18,600) |
| Cash Flow from Financing Activities | | |
| Additional Notes Payable | 10,000 | |
| Issuance of Common Stock | 5,000 | |
| Payment of Dividends | $(30,000) | |
| Net Cash Flow from Financing Activities | | (15,000) |
| Total Cash Flow Increase/Decrease | | 20,000 |
| Beginning Cash Balance | | 90,000 |
| Ending Cash Balance | | $110,000 |

**Figure 5.19 Full Statement of Cash Flows**

## Analyzing Performance

The statement of cash flows can be used in a number of ways to assess firm performance by both internal and external financial statement users. Internal users can assess sources of and uses of cash in order to aid in adapting, as necessary, to ensure adequate future cash flows. External users also use the statement. Recall that comparing net income to operational cash flows can help assess the quality of earnings. In the next section you'll explore operating cash flow and **free cash flow** to the firm, two key points of analysis in assessing cash flows.

# 5.6 Operating Cash Flow and Free Cash Flow to the Firm (FCFF)

### Learning Outcomes

By the end of this section, you will be able to:

- Calculate operating cash flow and free cash flow.
- Assess organizational cash management performance.

## Operating Cash Flow

Now that we have a statement of cash flows prepared, we can move on to a few key elements of the statement used to assess organizational cash management performance. Operating cash flow, or net cash flow from operating activities, is calculated in the first section of the statement of cash flows. It depicts the cash generated (or used by) the primary business activities. Remember, operating cash flow is calculated under the indirect method by adjusting net income for noncash expenses like depreciation and adjustments for changes in current asset and liability accounts (changes in net working capital).

$$\text{Operating Cash Flow} = \text{Operating Income} + \text{Depreciation} - \text{Taxes} + \text{Change in Net Working Capital} \quad \textbf{5.6}$$

Operating cash flow is helpful in assessing organizational cash management performance as it relates to the

core business function—operations. Key management practices in this area can have a profound impact on the firm's cash flow. Practices and policies include customer payment terms, collection policies and practices, and vendor payment terms. Though changing a customer or vendor payment terms will not change the profit or loss for the firm, it will have an impact on the timing to cash flows. This is a key element of managing operational cash flow.

## Free Cash Flow

Free cash flow (FCF) is calculated by taking operating cash flows less capital expenditures. Free cash flow is an important measure, as it depicts the cash available to support the business's operations and maintain its fixed assets. It is commonly used by investors as part of their overall evaluation of an investment, as it is a key measure of cash flow management practices and a firm's ability to generate enough cash to cover operations and capital assets and it shows if there is any left over for other considerations such as dividend payments, debt repayment, and contributions to increase working capital for future growth.

$$\text{Free Cash Flow (FCF)} = \text{Operating Cash Flow} - \text{Capital Expenditures} \quad \textbf{5.7}$$

Using the data for Clear Lake Sporting Goods, we can calculate its free cash flow as follows:

$$\text{Free Cash Flow (FCF)} = \$53{,}600 - \$13{,}600 = \$40{,}000 \quad \textbf{5.8}$$

This means that Clear Lake Sporting Goods has $40,000 of cash available to repay debt or pay cash dividends after having covered the cash needs of its operations and capital asset investments.

## Managing Cash Flow

Managing cash flow is not an easy task. A firm has a myriad of places that its cash flows from or to. However, there are a few key areas to place attention in order to manage or improve cash flows. First, consider where cash is coming from—customers. Managing terms and collection efforts with customers can have a significant impact on a firm's cash flow. For example, a customer with terms of net 10 will likely yield payment quite quickly—10 days, give or take. A customer with terms of net 60, on the other hand, will require roughly 60 days to collect assuming they pay on time. The 50-day difference between these two examples means that the firm will go 50 additional days having expended the resources to provide the customer their good or service, but with no cash flow yet to cover it.

The same theory holds true on the opposite side with accounts payable and the vendors a firm uses. Accepting net 10 terms requires the firm to give up its cash quickly, while pushing for more favorable terms like net 30 or net 60 allows the firm to wait much longer to give up its cash.

It is important to assess both sides of cash flow and the impact it has on the firm as well as the customer and vendor relationships it maintains. Some customers may not have difficulty negotiating a more favorable payment term in order for the firm to improve its cash flow. Others, however, may not be willing to accept shorter payment terms. In order to be competitive in the industry, the firm must assess the customer relationships, industry standards, and its own ability to support cash flow when considering its customer payment terms.

When there is a gap in cash flow, it is crucial that it is recognized early, with proper cash flow forecasting, so financing can be obtained to bridge the gap. A common tool used to manage the ebb and flow of cash flow for a firm is an open line of credit with a bank. This allows the firm to borrow and repay from month to month as cash flow fluctuates.

Now that you've become more familiar with the four basic financial statements, let's move on to a tool helpful in evaluating them: common-size statements. Common-size financial statements, also termed vertical analysis, restate the financial statement items as a percentage of a base item. Doing so helps reveal relationships between items, aids in assessing performance over time, and makes it easier to compare one company to another, regardless of size (thus the name common-size).

# 5.7 Common-Size Statements

## Learning Outcomes

By the end of this section, you will be able to:

- Prepare common-size statements.
- Assess organizational performance using common-size statements.
- Use industry comparisons to assess organizational performance.

## Common-Size Income Statements

A common-size income statement is created by restating each line as a percentage of net sales. Expressing each item on the income statement as a percentage rather than in absolute dollars makes it much easier to make comparisons, particularly to other divisions or competitors of varying sizes. The formula to calculate each item on the income statement is:

$$\text{Common-Size Item} = \frac{\text{Income Statement Line Item}}{\text{Net Sales}} \quad 5.9$$

Using Clear Lake Sporting Goods' current year income statement, we can see how each line item in it is divided by net sales in order to assemble a common-size income statement (see Figure 5.20).

**Clear Lake Sporting Goods**
**Comparative Year-End Income Statements**

| | Current Year | Current Year % | Formula |
|---|---|---|---|
| Gross Sales | $126,000 | | |
| Sales Returns & Allowances | 6,000 | | |
| Net Sales | 120,000 | 100% | =120,000/120,000 |
| Cost of Goods Sold | 60,000 | 50% | =60,000/120,000 |
| Gross Margin | 60,000 | 50% | =60,000/120,000 |
| Rent Expense | 5,500 | 5% | =5,500/120,000 |
| Depreciation Expense | 3,600 | 3% | =3,600/120,000 |
| Salaries Expense | 5,400 | 5% | =5,400/120,000 |
| Utility Expense | 2,500 | 2% | =2,500/120,000 |
| Operating Income | 43,000 | 36% | =43,000/120,000 |
| Interest Expense | 2,000 | 2% | =2,000/120,000 |
| Income Tax Expense | 6,000 | 5% | =6,000/120,000 |
| Net Income | $ 35,000 | 29% | =35,000/120,000 |

**Figure 5.20 Common-Size Income Statement**

It may seem cumbersome to create a common-size statement. However, a simple tool like Microsoft Excel can be quite handy in making the process easier and faster. The same formula can be copied and replicated in each income statement line, making the calculations much faster. In Figure 5.21, you can see the formulas used to create Clear Lake Sporting Goods' common-size income statement in Excel. Notice that the $ can be inserted to anchor a cell reference, making it easier to copy and paste the same formula onto many lines or columns.

| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| 1 | | Prior Year | Prior Year % | Formula | Current Year | Current Year % | Formula |
| 2 | Gross Sales | $ 105,000 | | | $ 126,000 | | |
| 3 | Sales Returns | 5,000 | | | 6,000 | | |
| 4 | Net Sales | 100,000 | 100% | =B4/$B$4 | 120,000 | 100% | =E4/$E$4 |
| 5 | Cost of Goods Sold | 50,000 | 50% | =B5/$B$4 | 60,000 | 50% | =E5/$E$4 |
| 6 | Gross Margin | 50,000 | 50% | =B6/$B$4 | 60,000 | 50% | =E6/$E$4 |
| 7 | Rent Expense | 5,000 | 5% | =B7/$B$4 | 5,500 | 5% | =E7/$E$4 |
| 8 | Depreciation Expense | 2,500 | 3% | =B8/$B$4 | 3,600 | 3% | =E8/$E$4 |
| 9 | Salaries Expense | 3,000 | 3% | =B9/$B$4 | 5,400 | 5% | =E9/$E$4 |
| 10 | Utility Expense | 1,500 | 2% | =B10/$B$4 | 2,500 | 2% | =E10/$E$4 |
| 11 | Operating Income | 38,000 | 38% | =B11/$B$4 | 43,000 | 36% | =E11/$E$4 |
| 12 | Interest Expense | 3,000 | 3% | =B12/$B$4 | 2,000 | 2% | =E12/$E$4 |
| 13 | Income Tax Expense | 5,000 | 5% | =B13/$B$4 | 6,000 | 5% | =E13/$E$4 |
| 14 | Net Income | $ 30,000 | 30% | =B14/$B$4 | $ 35,000 | 29% | =E14/$E$4 |

**Figure 5.21 Clear Lake Sporting Goods Common-Size Income Statements with Excel Formulas**

## Common-Size Balance Sheet

The common-size balance sheet functions much like the common-size income statement. Each line item on the balance sheet is restated as a percentage of total assets.

$$\text{Common-Size Item} = \frac{\text{Balance Sheet Line Item}}{\text{Total Assets}} \quad \textbf{5.10}$$

Using Clear Lake Sporting Goods' current balance sheet, we can see how each line item in its statement is divided by total assets in order to assemble a common-size balance sheet (see Figure 5.22).

| Clear Lake Sporting Goods<br>Comparative Year-End Balance Sheets | | | |
|---|---|---|---|
| | Current Year | Current Year % | Formula |
| **Assets** | | | |
| **Current Assets:** | | | |
| Cash | $110,000 | 44% | =110,000/250,000 |
| Accounts Receivable | 30,000 | 12% | =30,000/250,000 |
| Inventory | 40,000 | 16% | =40,000/250,000 |
| Short-Term Investments | 20,000 | 8% | =20,000/250,000 |
| **Total Current Assets** | 200,000 | 80% | =200,000/250,000 |
| **Noncurrent Assets:** | | | |
| Equipment | 50,000 | 20% | =50,000/250,000 |
| **Total Assets** | 250,000 | 100% | =250,000/250,000 |
| **Current Liabilities:** | | | |
| Accounts Payable | 75,000 | 30% | =75,000/250,000 |
| Unearned Revenue | 25,000 | 10% | =25,000/250,000 |
| **Total Current Liabilities** | 100,000 | 40% | =100,000/250,000 |
| **Noncurrent Liabilities:** | | | |
| Notes Payable | 50,000 | 20% | =50,000/250,000 |
| **Total Liabilities** | 150,000 | 60% | =150,000/250,000 |
| **Stockholder Equity** | | | |
| Common Stock | 80,000 | 32% | =80,000/250,000 |
| Ending Retained Earnings | 20,000 | 8% | =20,000/250,000 |
| Total Stockholders' Equity | 100,000 | 40% | =100,000/250,000 |
| **Total Liabilities and Stockholder Equity** | $250,000 | 100% | =250,000/250,000 |

**Figure 5.22 Common-Size Balance Sheet**

Excel can also be used to create a common-size balance sheet. Once the formula is created, it can be copied into each line, making the process to create a common-size statement much easier (see Figure 5.23):

| | A | B | C | D |
|---|---|---|---|---|
| 1 | | **Current Year** | **Current Year %** | **Formula** |
| 2 | **Assets** | | | |
| 3 | **Current Assets:** | | | |
| 4 | Cash | $ 110,000 | 44% | =B4/B$11 |
| 5 | Accounts Receivable | 30,000 | 12% | =B5/B$11 |
| 6 | Inventory | 40,000 | 16% | =B6/B$11 |
| 7 | Short-Term Investments | 20,000 | 8% | =B7/B$11 |
| 8 | **Total Current Assets** | 200,000 | 80% | =B8/B$11 |
| 9 | **Noncurrent Assets:** | | | |
| 10 | Equipment | 50,000 | 20% | =B10/B$11 |
| 11 | **Total Assets** | $ 250,000 | 100% | =B11/B$11 |
| 12 | **Current Liabilities:** | | | |
| 13 | Accounts Payable | 75,000 | 30% | =B13/B$11 |
| 14 | Unearned Revenue | 25,000 | 10% | =B14/B$11 |
| 15 | **Total Current Liabilities** | 100,000 | 40% | =B15/B$11 |
| 16 | **Noncurrent Liabilities:** | | | |
| 17 | Notes Payable | 50,000 | 20% | =B17/B$11 |
| 18 | **Total Liabilities** | 150,000 | 60% | =B18/B$11 |
| 19 | **Stockholder Equity** | | | |
| 20 | Common Stock | 80,000 | 32% | =B20/B$11 |
| 21 | Ending Retained Earnings | 20,000 | 8% | =B21/B$11 |
| 22 | Total Stockholders' Equity | 100,000 | 40% | =B22/B$11 |
| 23 | **Total Liabilities and Stockholder Equity** | $ 250,000 | 100% | =B23/B$11 |

**Figure 5.23 Common-Size Balance Sheet with Excel Formulas**

It is important to note that while we have provided two years of data here to explore the process, when performing analysis for a firm or investment, several years of data are commonly used to provide a better view of historical performance.

## Analyzing Organizational Performance

Common-size financial statements facilitate the analysis of financial performance by converting each element of the statements to a percentage. This makes it easier to compare figures from one period to the next, compare departments within an organization, and compare the firm to other companies of any size as well as industry averages. On the income statement, analysts can see how much of sales revenue is spent on each type of expense. They can see this breakdown for each firm and compare how different firms function in terms of expenses, proportionally. They can also look at the percentage for each expense over time to see if they are spending more or less on certain areas of the business, such as research and development. On the balance sheet, analysts commonly look to see the percentage of debt and equity to determine capital structure. They can also quickly see the percentage of current versus noncurrent assets and liabilities.

In Clear Lake Sporting Goods' common-size income statement for the current and prior years, we can see that cost of goods as a percentage of sales remained the same (see Figure 5.24). This means that while sales

increased, so did cost of goods sold, but it increased at the same proportion as sales. No improvement or decline occurred in the company's cost of goods sold. The same is true for rent, depreciation, and utilities expenses. One key item did change slightly as a percentage: salaries expense. The 2 percent decrease in operating income from the prior year's 38 percent to the current year's 36 percent was caused by the increase in salaries expense as a percentage of sales.

Net income, however, only declined by 1 percent from 30 percent in the prior year to 29 percent in the current year because interest expense dropped by 1 percent, offsetting the 2 percent increase in salaries expense.

**Clear Lake Sporting Goods**
**Comparative Year-End Income Statements**

| | Prior Year | Prior Year % | Current Year | Current Year % |
|---|---|---|---|---|
| Gross Sales | $105,000 | | $126,000 | |
| Sales Returns & Allowances | 5,000 | | 6,000 | |
| Net Sales | 100,000 | 100% | 120,000 | 100% |
| Cost of Goods Sold | 50,000 | 50% | 60,000 | 50% |
| Gross Profit | 50,000 | 50% | 60,000 | 50% |
| Rent Expense | 5,000 | 5% | 5,500 | 5% |
| Depreciation Expense | 2,500 | 3% | 3,600 | 3% |
| Salaries Expense | 3,000 | 3% | 5,400 | 5% |
| Utility Expense | 1,500 | 2% | 2,500 | 2% |
| Operating Income | 38,000 | 38% | 43,000 | 36% |
| Interest Expense | 3,000 | 3% | 2,000 | 2% |
| Income Tax Expense | 5,000 | 5% | 6,000 | 5% |
| Net Income | $ 30,000 | 30% | $ 35,000 | 29% |

**Figure 5.24 Common-Size Income Statement**

## LINK TO LEARNING

### Common-Size Income Statement

Visit the Apple, Inc. Common-Size Income Statement (https://openstax.org/r/common-size-income-statement) provided by the Stock Analysis on Net website. Review the company's cost of sales, gross profit, operating income, other income, and net income percentages for the current and prior year. What can you learn about the company's recent performance in these areas? Has it improved or declined, or has it simply changed incrementally with gross sales?

On the Clear Lake Sporting Goods' common-size balance sheet, we see that current assets remained at 80 percent of total assets from the prior to current year (see Figure 5.25). The mix of current assets that comprise that 80 percent changed only slightly with a 1 percent decrease in cash, 2 percent increase in accounts receivable, 2 percent decrease in inventory, and no change in short-term investments. Noncurrent assets includes only equipment. While the balance in the equipment account did change as a percentage of total assets, equipment remained the same at 20 percent.

On the debt and equity side of the balance sheet, however, there were a few percentage changes worth noting. In the prior year, the balance sheet reflected 55 percent debt and 45 percent equity. In the current year, that balance shifted to 60 percent debt and 40 percent equity. The firm did issue additional stock and showed an increase in retained earnings, both totaling a $10,000 increase in equity. However, the equity increase was much smaller than the total increase in liabilities of $40,000. Long-term debt increased by only $10,000 by issuing additional notes payable. The remainder of that increase is seen in the 5 percent increase in current liabilities. In that increase, most of it was in unearned revenue.

| Clear Lake Sporting Goods<br>Comparative Year-End Balance Sheets | | | | |
|---|---|---|---|---|
| | **Prior Year** | **Prior Year %** | **Current Year** | **Current Year %** |
| **Assets** | | | | |
| **Current Assets:** | | | | |
| Cash | $ 90,000 | 45% | $110,000 | 44% |
| Accounts Receivable | 20,000 | 10% | 30,000 | 12% |
| Inventory | 35,000 | 18% | 40,000 | 16% |
| Short-Term Investments | 15,000 | 8% | 20,000 | 8% |
| **Total Current Assets** | 160,000 | 80% | 200,000 | 80% |
| **Noncurrent Assets:** | | | | |
| Equipment | 40,000 | 20% | 50,000 | 20% |
| **Total Assets** | 200,000 | 100% | 250,000 | 100% |
| **Current Liabilities:** | | | | |
| Accounts Payable | 60,000 | 30% | 75,000 | 30% |
| Unearned Revenue | 10,000 | 5% | 25,000 | 10% |
| **Total Current Liabilities** | 70,000 | 35% | 100,000 | 40% |
| **Noncurrent Liabilities:** | | | | |
| Notes Payable | 40,000 | 20% | 50,000 | 20% |
| **Total Liabilities** | 110,000 | 55% | 150,000 | 60% |
| **Stockholder Equity** | | | | |
| Common Stock | 75,000 | 38% | 80,000 | 32% |
| Ending Retained Earnings | 15,000 | 8% | 20,000 | 8% |
| Total Stockholders' Equity | 90,000 | 45% | 100,000 | 40% |
| **Total Liabilities and Stockholder Equity** | $200,000 | 100% | $250,000 | 100% |

**Figure 5.25 Common-Size Balance Sheet**

LINK TO LEARNING

Common-Size Assets and Common-Size Liabilities and Equity

Visit the Apple, Inc. Common-Size Assets (https://openstax.org/r/common-size-assets) Balance Sheet and Common-Size Liabilities and Equity (https://openstax.org/r/common-size-liabilities) Balance Sheet provided by the Stock Analysis on Net website. Review the composition of the company's assets, liabilities, and equity. How have assets changed? Has capital structure changed? If so, what elements impacted the change?

## Industry Comparison

Recall that a key benefit of common-size analysis is comparing the firm's performance to the industry. Expressing the figures on the income statement and balance sheet as percentages rather than raw dollar figures allows for comparison to other companies regardless of size differences.

Clear Lake Sporting Goods, for example, might compare their financial performance on their income statement to a key competitor, Charlie's Camping World. Charlie is a much bigger retailer for outdoor gear, as Charlie has nearly seven times greater sales than Clear Lake. Common-size statements allow Clear Lake to compare their statements in a meaningful way (see Figure 5.26). Notice that Clear Lake spends 50 percent of its sales on cost of goods sold while Charlie spends 59 percent. This is a significant difference that would be an indicator that Clear Lake and Charlie have key differences in their operations, purchasing policies, or general performance in their core products.

We know that Charlie is a bigger retailer, and we see this clearly in the rent expense as a percentage of sales.

Charlie spends 11 percent of its sales on building rent, while Clear Lake spends only 5 percent. A clear difference in performance is hinted at here, alluding to Charlie spending more per square foot on rent or using its retail space differently, causing it to rent more space for its product per sales dollar than Clear Lake does. Depreciation expense, though not a large figure, is smaller for Charlie, giving us a hint that Charlie has less capital equipment than Clear Lake, perhaps tied to the higher rent expense. It is possible that Charlie rents some of its equipment, which would help explain the higher rent percentage. Finally, Charlie's salaries percentage is significantly higher at 12 percent than Clear Lake's 5 percent. Though the simple percentage does not tell us why, it does provide us a hint and allow for further questions or investigation. Charlie may pay its employees a much higher wage than Clear Lake. They may also have far more sales associates on the floor in their larger spaces than Clear Lake does in their smaller retail spaces.

Note that although we have compared just two years of data for Charlie and Clear Lake, it is more common to use several years of data to get a more robust view of long-term trends.

| | Charlie's Camping World Common-Size Income Statement | | Clear Lake Sporting Goods Common-Size Income Statement | |
|---|---|---|---|---|
| | Prior Year | Prior Year % | Current Year | Current Year % |
| Gross Sales | $748,000 | | $126,000 | |
| Sales Returns & Allowances | 41,000 | | 6,000 | |
| Net Sales | 707,000 | 100% | 120,000 | 100% |
| Cost of Goods Sold | 418,000 | 59% | 60,000 | 50% |
| Gross Profit | 289,000 | 41% | 60,000 | 50% |
| Rent Expense | 75,000 | 11% | 5,500 | 5% |
| Depreciation Expense | 5,000 | 1% | 3,600 | 3% |
| Salaries Expense | 85,000 | 12% | 5,400 | 5% |
| Utility Expense | 25,000 | 4% | 2,500 | 2% |
| Operating Income | 99,000 | 14% | 43,000 | 36% |
| Interest Expense | 1,000 | 0% | 2,000 | 2% |
| Income Tax Expense | 14,000 | 2% | 6,000 | 5% |
| Net Income | $ 84,000 | 12% | $ 35,000 | 29% |

**Figure 5.26 Comparison of Common-Size Income Statements**

## LINK TO LEARNING

### Microsoft versus Apple

Locate the sales, cost of goods sold, and gross profit data for Microsoft (https://openstax.org/r/microsoft-financial)'s most current period using Yahoo! Finance. Calculate the common-size percentage for cost of goods sold and gross profit (cost of goods sold divided by net sales, and gross profit divided by net sales). Compare these percentages to those of Apple, Inc (https://openstax.org/r/common-size-income-statement)., a key competitor, on its common-size income statement. What can you learn about the performance of each firm based on these two percentages?

Now that you have covered the basic financial statements and a little bit about how they are used, where do we find them? How often are they prepared? Who gets them? In this next section we will explore the requirements for what needs to be reported, when, and to whom.

# 5.8 Reporting Financial Activity

## Learning Outcomes

By the end of this section, you will be able to:

- Identify the most common types of accounting periods.
- Outline key considerations and accounting principles that dictate the timing of financial reporting.
- Describe the SEC reporting requirements relevant to financial statements.
- Identify the key elements of a company annual report.

## Defining Accounting Periods

An accounting period can be any period of time, but the most common accounting periods are months, quarters, and a year. Accounting periods are important, particularly in accrual accounting, so there are clear cutoffs for recording transactions.

It is important to note that Generally Accepted Accounting Principles (GAAP) require companies to provide quarterly financial statements. However, most firms, even those not covered by GAAP, prepare financial statements monthly in order to provide timely data to their financial statement users both internally and externally.

### Time Period Principle

Providing information to financial statement users in a timely fashion brings us to our next key topic, which is the time period principle. In order for information to be useful, it must be timely. This means that financial statement users need to get the statements quickly enough to be able to make relevant decisions with them. Providing statements on a timely basis is the foundation of the time period accounting principle.

### Fiscal versus Calendar Year

Though a firm may present financial statements monthly, quarterly, and annually, not all time periods are created equal. Firms have the option to choose between a fiscal and a calendar year. The calendar year, which begins January 1 and ends December 31, is the traditional year we are accustomed to. The calendar year, however, doesn't always work well with a firm's business cycle. Due to seasonality or other factors, a firm may choose to adopt a fiscal year with their own beginning and end date. For example, a firm may choose to start its fiscal year on June 1 and end it on May 31. A firm can opt to change from a fiscal to a calendar year or vice versa but must only do so for a justifiable reason.

**THINK IT THROUGH**

#### Fiscal versus Calendar Year

Visit the Apple, Inc. Annual Report (https://openstax.org/r/2020-doc-financial-annual-report) for 2020 and review the title of the table of contents on page 1. The title reads "Apple Inc. Form 10-K." The next line provides information on the company's chosen time period. Does Apple use a fiscal or calendar year?

**Solution:**

Apple uses a fiscal year. Their fiscal year ended on September 26, 2020.

## The Annual Report

An annual report is part of the 10-K filing that publicly traded firms must provide to the SEC and investors each year. The report details the firm's operations and performance for the year and its current financial conditions. The report contains general company information, the firm's financial statements, notes to the financial

statements, various required disclosures pertaining to accounting policies, the management discussion and analysis (MD&A) statement, a letter from the CEO to the shareholders, and the firm's audit report.

THINK IT THROUGH

### Annual Report Key Elements

Visit the Apple, Inc. Annual Report (https://openstax.org/r/2020-doc-financial-annual-report) for 2020 and review the title of the table of contents on page 1. What key elements would you be drawn to review if you were a potential investor? In Part II of the table of contents, find the MD&A report (page 20) and use the table of contents link to navigate to it. What key highlights and challenges did the company report for the year?

**Solution:**

Answers may vary. A few key items of note might include risk factors, financial statements, the MD&A letter, and disclosures about market risk. Apple's MD&A reported significant updates on the impact of the COVID-19 pandemic, a few financial updates, product updates, segment performance data, a conversation about its debt, contractual obligations, and accounting policies.

## SEC Reporting Requirements

The Securities and Exchange Commission (SEC) requires publicly traded firms to regularly provide several reports. The two most common are the 10-K and quarterly report (10-Q). Certain unique events also require an additional filing called an 8-K. There are many events that might require reporting. A few key examples include changes to rights of shareholders, changes in control of the company, and amendments to the company charter or bylaws.

The quarterly report is much like the annual report already discussed. It contains the firm's financial statements, required accounting disclosures, statements on internal control, and a management discussion and analysis (MD&A) letter. It does not contain an auditor's report, as firms are not audited on a quarterly basis. Quarterly reports are helpful to investors because they provide information on a timely enough basis to be relevant.

LINK TO LEARNING

### Investor Relations

Visit the Apple, Inc. Investor Relations page, SEC Filings section (https://openstax.org/r/sec-filings). Notice how many different reports Apple files regularly with the SEC. Locate the most recent quarterly (10-Q) and annual reports (10-K) and scan the table of contents. How does the quarterly report differ from the annual report? Do you notice key items in the annual report not provided in the quarterly report?

# Summary

## 5.1 The Income Statement

The income statement reflects a firm's performance over a period of time. Most financial statements are prepared monthly, quarterly, and annually. The income statement reflects sales less cost of goods sold to arrive at gross profit. Operating costs are deducted to arrive at operating income. Finally, other nonoperational costs like interest and taxes are deducted to arrive at net income.

## 5.2 The Balance Sheet

The balance sheet reflects the financial position of a firm as of a particular point in time. It is laid out to clearly depict and support the accounting equation: $\text{assets} = \text{liabilities} + \text{owner's equity}$. A classified balance sheet breaks down the assets and liabilities sections into current and noncurrent for greater transparency.

## 5.3 The Relationship between the Balance Sheet and the Income Statement

The financial statements are all tied together. The income statement is generated first, as net income is needed in order to determine the ending balance of retained earnings, a key account in the equity section of the balance sheet.

## 5.4 The Statement of Owner's Equity

The statement of owner's equity is divided by each type of equity the firm has: common stock, preferred stock, additional paid-in capital, and retained earnings, for example. Beginning balances are provided, and all key transactions impacting equity are provided in order to show how ending balance were derived. Key transactions commonly include recording net income or loss, issuing additional stock, and paying out dividends.

## 5.5 The Statement of Cash Flows

Under accrual accounting, transactions are recorded when they occur, not necessarily when cash moves. This creates a timing difference. Net profit, therefore, does not necessarily mean a firm has cash, and a net loss doesn't mean they don't have any cash. To reconcile net income to actual cash flow and see how a firm generates and uses its funds, a statement of cash flows is prepared. The statement reflects cash flow from operating activities, financing activities, and investing activities.

## 5.6 Operating Cash Flow and Free Cash Flow to the Firm (FCFF)

Operating cash flow reflects the cash generated by (or used by) the core business function. Free cash flow to the firm (FCFF) or simply free cash flow (FCF) is calculated by deducting capital expenditures from operating cash flow. FCF reflects the cash available to repay debts, pay dividends to shareholders, and contribute to cash needs for growth.

## 5.7 Common-Size Statements

Common-size statements are a restatement of the financial statements with all dollar figures restated as a percentage. On the income statement, each line is restated as a percentage of net sales. On the balance sheet, each line is restated as a percentage of total assets. Common-size statements are useful for analysis and are particularly helpful in comparing firms of different sizes.

## 5.8 Reporting Financial Activity

Publicly traded firms must file company and financial data with the Securities and Exchange Commission (SEC) on a regular basis. Key reports include the quarterly report, called a 10-Q, and the annual report, called a 10-K.

## Key Terms

**accounting equation** $\text{assets} = \text{liabilities} + \text{owner's equity}$
**accrual basis** accounting system in which revenue is recorded or recognized when earned yet not necessarily received, and in which expenses are recorded when legally incurred and not necessarily when paid
**assets** tangible or intangible resources owned or controlled by a company, individual, or other entity with the intent that they will provide economic value
**cash basis** method of accounting in which transactions are not recorded in the financial statements until there is an exchange of cash
**current assets** asset typically used up, sold, or converted to cash in one year or less
**current liabilities** debt or obligation due within one year or, in rare cases, a company's standard operating cycle, whichever is greater
**depreciation** process of allocating the costs of a tangible asset over the asset's economic life
**direct method** approach used to determine net cash flows from operating activities, whereby accrual basis revenue and expenses are converted to cash basis collections and payments
**dividends** portion of the net worth (equity) that is returned to owners of a corporation as a reward for their investment
**expenses** costs associated with providing goods or services
**free cash flow** operating cash, reduced by expected capital expenditures
**gains** increases in organizational value from activities that are "incidental or peripheral" to the primary purpose of the business
**income statement** financial statement that measures the organization's financial performance for a given period of time
**indirect method** approach used to determine net cash flows from operating activities, starting with net income and adjusting for items that impact new income but do not require outlay of cash
**liabilities** probable future sacrifice of economic benefits arising from present obligations of a particular entity to transfer assets or provide services to other entities in the future as a result of past transactions or events
**loss** decrease in organizational value from activities that are "incidental or peripheral" to the primary purpose of the business
**net income** revenues and gains that are greater than expenses and losses
**noncash expenses** expenses that reduce net income but are not associated with a cash flow; most common example is depreciation expense
**noncurrent assets** assets used in the normal course of business for more than one year that are not intended to be resold
**noncurrent liabilities** liabilities that are expected to be settled in more than one year
**owner's equity** residual interest in the assets of an entity that remains after deducting its liabilities
**retained earnings** cumulative, undistributed net income or net loss for the business since its inception
**revenue** inflows or other enhancements of assets of an entity or settlements of liabilities from delivering or producing goods, rendering services, or other activities that constitute the entity's ongoing major or central operations
**statement of cash flows** financial statement listing the cash inflows and cash outflows for the business for a period of time

## CFA Institute

This chapter supports some of the Learning Outcome Statements (LOS) in this CFA® Level I Study Session (https://openstax.org/r/media-document-study-session). Reference with permission of CFA Institute.

## Multiple Choice

1. Which of the following is a measure of the performance of a firm's daily operations?
   **a.** gross profit
   **b.** cost of goods sold
   **c.** operating income
   **d.** net income

2. In which section of the classified balance sheet would you find a note payable due in six months?
   **a.** current assets
   **b.** current liabilities
   **c.** noncurrent liabilities
   **d.** common stock

3. Which financial statement must be prepared first?
   **a.** statement of retained earnings
   **b.** balance sheet
   **c.** statement of cash flows
   **d.** income statement

4. Which of the following represents earned capital on the statement of owner's equity?
   **a.** retained earnings
   **b.** common stock
   **c.** preferred stock
   **d.** additional paid-in capital

5. Which section of the statement of cash flows reflects the cash generated from or used by a company's day-to-day operations?
   **a.** investing activities
   **b.** financing activities
   **c.** operating activities
   **d.** noncash activities

6. How do you calculate free cash flow (FCF)?
   **a.** net income less dividends
   **b.** operating income less capital expenditures
   **c.** gross profit less depreciation
   **d.** net income plus interest

7. How do you calculate common-size analysis on the income statement?
   **a.** income statement line item/gross profit
   **b.** income statement line item/net income
   **c.** net sales/income statement line item
   **d.** income statement line item/net sales

8. Which of the following does not represent a filing commonly required by the SEC?
   **a.** annual report, 10-K
   **b.** quarterly report, 10-Q
   **c.** Form 8-K
   **d.** 1040

## Review Questions

1. What is the difference between gross profit and net income?

2. If a classified balance sheet has total assets of $900,000 and total owner's equity of $350,000, what must the company's total liabilities be?
3. What key element of the income statement flows through to the balance sheet?
4. What key columns are commonly found on the statement of owner's equity?
5. Ted's firm reported net income for the current period of $65,750. Is it safe to assume that because Ted's firm reported such a large net income, it has plenty of cash to fund its operations? Why or why not?
6. What useful insights does free cash flow (FCF) provide in financial analysis?
7. Describe how common-size statements are useful.
8. What is the difference between a calendar year and a fiscal year?

## Problems

1. Rickey's Retail has the following financial information for the most recent accounting period. Prepare an income statement.

| Rickey's Retail<br>Income Statement | |
|---|---|
| Gross Sales | $864,740 |
| Sales Returns & Allowances | 47,399 |
| Cost of Goods Sold | 483,237 |
| Rent Expense | 86,705 |
| Interest Expense | 1,156 |
| Income Tax Expense | 16,185 |
| Depreciation Expense | 5,780 |
| Salaries Expense | 98,266 |
| Utility Expense | $ 28,902 |

2. Big Box has the following accounts. In which section of its classified balance sheet does each belong?
   - Cash
   - Wages payable
   - Taxes payable
   - Accounts receivable
   - Retained earnings
   - Common stock
   - Land
   - Note payable due in 10 years
   - Prepaid insurance
3. Big Box Outlet has $10,350 of supplies expense on its income statement. Does this mean that there must also be a supplies payable account balance of $10,350 on its balance sheet? Why or why not?
4. What are the three key types of dividends a firm might distribute to their shareholders? Describe each.
5. Big Box Outlet had an increase in its accounts payable account this period and a decrease in its accounts receivable, took out a long-term note payable, paid dividends to its shareholders, had depreciation on its equipment, bought new equipment, increased its inventory account, and repaid a bond. In which section of the statement of cash flows would each of these items appear?
6. Kokoya's Firm calculates its free cash flow at only $2,000, which the company feels is quite low based on its historical performance and compared to others in its industry. What actions might Kokoya's Firm take to

improve its overall cash flow?

7. Complete the common-size income statement for Big Box Outlet using the information below:

| Big Box Outlet<br>Common-Size Income Statement | | |
|---|---|---|
| | **Current Year** | **Current Year %** |
| Gross Sales | $1,089,836 | _____ |
| Sales Returns & Allowances | 59,737 | _____ |
| Net Sales | 1,030,099 | _____ |
| Cost of Goods Sold | 609,026 | _____ |
| Gross Profit | 421,073 | _____ |
| Rent Expense | 109,275 | _____ |
| Depreciation Expense | 7,285 | _____ |
| Salaries Expense | 123,845 | _____ |
| Utility Expense | 36,425 | _____ |
| Operating Income | 144,243 | _____ |
| Interest Expense | 1,457 | _____ |
| Income Tax Expense | 20,398 | _____ |
| Net Income | $ 122,388 | |

8. List at least eight items commonly found in a firm's annual report filed with the SEC.

## Video Activity

### The Income Statement Explained

Access multimedia content (http://openstax.org/books/principles-finance/pages/5-video-activity)

1. In the video, you see two years of data for Imaginary Ltd. The company had the same sales and same operating profit in both years. However, its performance really wasn't the same from one year to the next. How do the details of the income statement help you see this? What key performance measures were you able to glean from the income statement?

2. Though the key elements of the income statement can be summarized as simply all the firm's revenues and expenses, how would you describe the elements of the income statement in more detail? Assume you were consulting for a friend who owns a small dairy farm. What items would you expect to see on their income statement? Make a list and be as detailed as you can. Curious if your list is accurate? Consider doing an online search to find an income statement for a dairy farm or similar business. Compare its income statement to your list to see if you had the right idea.

### How the Balance Sheet Works

Access multimedia content (http://openstax.org/books/principles-finance/pages/5-video-activity)

3. In the video, before the example started, a fair amount of discussion time was devoted to the accounting equation, double-entry accounting, and the past versus the present data. How do all of these concepts tie together in the balance sheet and the type of data we can hope to glean from a balance sheet?

4. Three key account types are represented on the balance sheet: assets, liabilities, and equity. Much like the income statement, however, there is a great deal more detail to a balance sheet than simply these three figures. What additional accounts and detail can you find on the balance sheet? If you were to look up the balance sheet for the company that sells your favorite thing (e.g., coffee, your laptop, your phone, candy), what types of accounts do you think you will find on its balance sheet? Consider doing an online search for the company's balance sheet to see if your guess is correct.

6

# Measures of Financial Health

**Figure 6.1** Organizations must continually measure their financial health in order to remain successful. (credit: "Money" by Pictures of Money/flickr, CC BY 2.0)

## Chapter Outline


**6.1** Ratios: Condensing Information into Smaller Pieces
**6.2** Operating Efficiency Ratios
**6.3** Liquidity Ratios
**6.4** Solvency Ratios
**6.5** Market Value Ratios
**6.6** Profitability Ratios and the DuPont Method


## Why It Matters

Financial analysis is a crucial element of business, but it can be used in personal finance as well. It differs depending on the role and perspective of those performing the analysis. For example, your personal accountant will have different goals and needs in making recommendations to you about your personal finances. All accounting professionals use financial analysis to check for validity, accurate data, compliance in reporting, and more.

Some tactics for managing your personal finances can be the same as for managing business finances. For example, reducing expenses and maximizing returns on long-term investments are always good practices. Debt can also be a beneficial tool in both personal and professional finances when used appropriately. Debt is neither inherently good nor bad; it simply needs to be properly managed in order to achieve a reasonable return in exchange for the cost and risk it poses.

Though the process and tools may be similar, financial analysis from a business perspective has different goals and needs. Investors are looking to identify firm performance, financial health, and profitability. Financial analysts closely review information found on financial statements so they can make informed business decisions. The income statement, statement of retained earnings, balance sheet, and statement of cash flows, among other financial information, are analyzed for internal and external stakeholders and provide a company with valuable information about its overall performance and specific areas for improvement. The analysis can help with budgeting and making decisions about where the company could cut costs, how it might increase

revenues, and what capital investment opportunities it should pursue.

LINK TO LEARNING

Financial Analyst

Lots of individuals and companies perform financial analysis. One of these roles is that of a financial analyst. The skills and qualifications of a financial analyst vary widely from one industry to another, but there are a number of similarities in individuals who hold these roles. As you watch the video about financial analysts (https://openstax.org/r/video-about-financial-analysts), consider your own career path and how your skills, abilities, and interests may fit this role.

# 6.1 Ratios: Condensing Information into Smaller Pieces

By the end of this section, you will be able to:

- Explain the importance of financial statement analysis in making informed decisions about business opportunities.
- Outline the limitations of financial statement analysis in making investment decisions.

When considering the outcomes from analysis, it is important for a company to understand that the data generated needs to be compared to similar data within the industry at large as well as that of close competitors. The company should also consider its past experience and how it corresponds to current and future performance expectations.

## Importance of Ratios and Analysis

Financial ratios help internal and external stakeholders make informed decisions about actions like investing, becoming a supplier, making a loan, or altering internal operations, among other things. The information resulting from ratio analysis can be used to examine trends in performance, establish benchmarks for success, set budget expectations, and compare industry competitors. There are four main types of ratios: liquidity, solvency, efficiency, and profitability. While outcomes for some ratios may seem more ideal, the industry in which the business operates can change the influence of these outcomes on stakeholder decisions.

There are several benefits to analyzing financial statements. The information can show trends over time, which can help in making future business decisions. Converting information to percentages or ratios eliminates some of the disparities between competitors' sizes and operating abilities, making it easier for stakeholders to make informed decisions. It can assist with understanding the makeup of current operations within the business and which shifts need to occur internally to increase productivity.

## Limitation of Financial Statement Analysis

Though useful, it's important to note that there are limitations to financial statement analysis as well. Stakeholders need to remember that past performance does not always predict future performance. Economic influences, such as inflation or a recession, could skew the data being analyzed. Additionally, the way a company reports information may change over time. For example, there could be changes in where and when certain transactions are recorded, and this may not be immediately evident to financial statement users. It is also key to note that though all publicly traded companies in the United States are required to follow Generally Accepted Accounting Principles (GAAP), there are many estimates and flexibility in how some standards are applied. This means that firms can still follow accounting standards appropriately but present some information differently from other firms.

It makes good sense for a company to use financial statement analysis to guide future operations so it can budget properly, control costs, increase revenues, and make long-term expenditure decisions. As long as

stakeholders understand the limitations of financial statement analysis, it is a useful way to predict growth and financial strength.

Despite limitations, ratios are still a valuable tool if used appropriately. The next section discusses several operating efficiency ratios including accounts receivable turnover, total asset turnover, inventory turnover, and days' sales in inventory. Operating efficiency ratios help users see how well management is using the financial assets of the firm.

# 6.2 Operating Efficiency Ratios

By the end of this section, you will be able to:

- Calculate accounts receivable turnover to assess a firm's performance in managing customer receivables.
- Evaluate management's use of assets using total asset turnover and inventory turnover.
- Assess organizational performance using days' sales in inventory calculations.

Efficiency ratios show how well a company uses and manages its assets, one key element of financial health. Important areas of efficiency are the management of sales, accounts receivable, and inventory. A company that is efficient will usually be able to generate revenues quickly using the assets it has acquired. Let's examine four **efficiency ratios**: accounts receivable turnover, total asset turnover, inventory turnover, and **days' sales in inventory**.

## Accounts Receivable Turnover

For our discussion of financial statement analysis, we will look at Clear Lake Sporting Goods. Clear Lake Sporting Goods is a small merchandising company (a company that buys finished goods and sells them to consumers) that sells hunting and fishing gear. Figure 6.2 shows the comparative income statements and balance sheets for the past two years.

**Clear Lake Sporting Goods**
**Comparative Year-End Income Statements**

| | Prior Year | Current Year |
|---|---|---|
| Net Sales | $100,000 | $120,000 |
| Cost of Goods Sold | 50,000 | 60,000 |
| Gross Profit | 50,000 | 60,000 |
| Rent Expense | 5,000 | 5,500 |
| Depreciation Expense | 2,500 | 3,600 |
| Salaries Expense | 3,000 | 5,400 |
| Utility Expense | 1,500 | 2,500 |
| Operating Income | 38,000 | 43,000 |
| Interest Expense | 3,000 | 2,000 |
| Income Tax Expense | 5,000 | 6,000 |
| Net Income | $ 30,000 | $ 35,000 |

**Clear Lake Sporting Goods**
**Comparative Year-End Balance Sheets**

| | Prior Year | Current Year |
|---|---|---|
| **Assets:** | | |
| Cash | $ 90,000 | $110,000 |
| Accounts Receivable | 20,000 | 30,000 |
| Inventory | 35,000 | 40,000 |
| Short-Term Investments | 15,000 | 20,000 |
| Total Current Assets | 160,000 | 200,000 |
| Equipment | 40,000 | 50,000 |
| **Total Assets** | $200,000 | $250,000 |
| **Liabilities:** | | |
| Accounts Payable | $ 60,000 | $ 75,000 |
| Unearned Revenue | 10,000 | 25,000 |
| Total Current Liabilities | 70,000 | 100,000 |
| Notes Payable | 40,000 | 50,000 |
| Total Liabilities | $110,000 | $150,000 |
| **Stockholder Equity** | | |
| Common Stock | 75,000 | 80,000 |
| Ending Retained Earnings | 15,000 | 20,000 |
| Total Stockholders' Equity | 90,000 | 100,000 |
| **Total Liabilities and Stockholder Equity** | $200,000 | $250,000 |

**Figure 6.2 Comparative Income Statements and Year-End Balance Sheets** Note that the comparative income statements and

balance sheets have been simplified here and do not fully reflect all possible company accounts.

To begin an analysis of receivables, it's important to first understand the cycles and periods used in the calculations.

## Operating Cycle

A period is one **operating cycle** of a business. The operating cycle includes the cash conversion cycle plus the accounts receivable cycle (discussed below). Essentially it is the time it takes a business to purchase or make inventory and then sell it. For example, assume Clear Lake Sporting Goods orders and receives a shipment of fishing lures on June 1. It stocks the shelves with lures and tracks its inventory and sales. By July 15, all the lures from that shipment are gone. In this example, Clear Lake's operating cycle is 45 days.

## Cash Conversion Cycle

Cash, however, doesn't necessarily flow linearly with accounting periods or operating cycles. The cash conversion cycle is the time it takes to spend cash to purchase inventory, produce the product, sell it, and then collect cash from the customer. Accounts receivable is one section of that cycle. Referring to Clear Lake's June 1 shipment of lures that sold by July 15, assume that some of the customers were fishing guides that keep an open account with Clear Lake. This company did not pay for its lures until August 15 when it settled its account. In this example, Clear Lake's cash cycle is 75 days.

Let's take a look at the accounts receivable turnover ratio, which helps assess that element of the cash conversion cycle.

## Accounts Receivable Turnover Ratio

Receivables ratios show company performance in relation to current receivables (what is due from customers), as well as credit policy effect on sales growth. One receivables ratio is called the **accounts receivable turnover ratio**.This ratio determines how many times (i.e., how often) accounts receivable are collected during a year and converted to cash. A higher number of times indicates that receivables are collected quickly. This quick cash collection may be viewed as a positive occurrence because liquidity improves, and the company may reinvest in its business sooner when the value of the dollar has more buying power (time value of money). The higher number of times may also be a negative occurrence, signaling that credit extension terms are too tight, and it may exclude qualified consumers from purchasing. Excluding these customers means that they may take their business to a competitor, thus reducing potential sales.

In contrast, a lower number of times indicates that receivables are collected at a slower rate. A slower collection rate could signal that lending terms are too lenient; management might consider tightening lending opportunities and more aggressively pursuing payment from its customers. The lower turnover also shows that the company has cash tied up in receivables longer, thus hindering its ability to reinvest this cash in other current projects. The lower turnover rate may signal a high level of bad debt accounts. The determination of a high or low turnover rate really depends on the standards of the company's industry. It's key to note the tradeoff in adjusting credit terms. Loose credit terms may attract more customers but may also increase bad debt expense. Tighter credit terms may attract fewer customers but may also reduce bad debt expense.

The formula for accounts receivable turnover is

$$\text{Accounts Receivable Turnover} = \frac{\text{Net Credit Sales}}{\text{Average Accounts Receivable}} \quad \textbf{6.1}$$

$$\text{Average Accounts Receivable} = \frac{\text{Beginning Accounts Receivable} + \text{Ending Accounts Receivable}}{2} \quad \textbf{6.2}$$

Net credit sales are sales made on credit only; cash sales are not included because they do not produce receivables. However, many companies do not report credit sales separately from cash sales, so "net sales" may be substituted for "net credit sales" in this case. Beginning and ending accounts receivable refer to the

beginning and ending balances in accounts receivable for the period. The beginning accounts receivable balance is the same figure as the ending accounts receivable balance from the prior period.

When computing the accounts receivable turnover for Clear Lake Sporting Goods, let's assume net credit sales make up $100,000 of the $120,000 of the net sales found on the income statement in the current year.

$$\text{Average Accounts Receivable} = \frac{\$20{,}000 + \$30{,}000}{2} = \$25{,}000 \quad \textbf{6.3}$$

$$\text{Accounts Receivable Turnover} = \frac{\$100{,}000}{\$25{,}000} = 4 \text{ times} \quad \textbf{6.4}$$

To gain a better understanding of its ratio performance, Clear Lake Sporting Goods can compare its turnover to industry averages, key competitors, and its own historical ratios. Given this outcome, the managers may want to consider stricter credit lending practices to make sure credit customers are of a higher quality. They may also need to be more aggressive with collecting any outstanding accounts.

### THINK IT THROUGH

#### Accounts Receivable Turnover

You are a consultant assessing cash management practices for two firms, Company A and Company B (see Figure 6.3).

| | Company A | Company B |
|---|---|---|
| Beginning Accounts Receivable | $ 50,000 | $ 60,000 |
| Ending Accounts Receivable | 80,000 | 90,000 |
| Net Credit Sales | $550,000 | $460,000 |

**Figure 6.3 Financial Information for Company A and Company B**

Based on the information provided, do the following:

- Compute the accounts receivable turnover ratio.
- Interpret the outcomes, indicating how each company is performing

**Solution:**

Company A: $\text{ART} = 8.46$ times, Company B: $\text{ART} = 6.13$ times. Upon initial review of this limited information, Company A seems to be performing better since its turnover ratio is higher. Accounts receivable turnover has a significant impact on cash flows. One might want more information on trends for each company with these ratios and a comparison to others in the same industry. More information is helpful in assessing performance.

### LINK TO LEARNING

#### American Superconductor Corporation

American Superconductor Corporation specializes in the production and service of energy-efficient wind turbine systems, as well as energy grid construction solutions. On the company's 2019 financial statement (https://openstax.org/r/financial-statement), the accounts receivable turnover ratio is approximately 6.32 times.

## Total Asset Turnover

**Total asset turnover** measures the ability of a company to use its assets to generate revenues. A company

would like to use as few assets as possible to generate the most net sales. Therefore, a higher total asset turnover means the company is using their assets very efficiently to produce net sales. The formula for total asset turnover is

$$\text{Total Asset Turnover} = \frac{\text{Net Sales}}{\text{Average Total Assets}} \quad \textbf{6.5}$$

$$\text{Average Total Assets} = \frac{\text{Beginning Total Assets} + \text{Ending Total Assets}}{2} \quad \textbf{6.6}$$

Average total assets are found by dividing the sum of beginning and ending total assets balances found on the balance sheet. The beginning total assets balance in the current year is taken from the ending total assets balance in the prior year.

Clear Lake Sporting Goods' total asset turnover is

$$\text{Average Total Assets} = \frac{\$200{,}000 + \$250{,}000}{2} = \$225{,}000 \quad \textbf{6.7}$$

$$\text{Total Asset Turnover} = \frac{\$120{,}000}{\$225{,}000} = 0.53 \text{ times (rounded)} \quad \textbf{6.8}$$

The outcome of 0.53 means that for every $1 of assets, $0.53 of net sales are generated. Over time, Clear Lake Sporting Goods would like to see this turnover ratio increase.

## Inventory Turnover

**Inventory turnover** measures how many times during the year a company has sold and replaced inventory. This can tell a company how well inventory is managed. A higher ratio is preferable; however, an extremely high turnover may mean that the company does not have enough inventory available to meet demand. A low turnover may mean the company has too much supply of inventory on hand. The formula for inventory turnover is

$$\text{Inventory Turnover} = \frac{\text{Cost of Goods Sold}}{\text{Average Inventory}} \quad \textbf{6.9}$$

$$\text{Average Inventory} = \frac{\text{Beginning Inventory} + \text{Ending Inventory}}{2} \quad \textbf{6.10}$$

Cost of goods sold for the current year is found on the income statement. Average inventory is found by dividing the sum of beginning and ending inventory balances found on the balance sheet. The beginning inventory balance in the current year is taken from the ending inventory balance in the prior year.

Clear Lake Sporting Goods' inventory turnover is

$$\text{Average Inventory} = \frac{\$35{,}000 + \$40{,}000}{2} = \$37{,}500 \quad \textbf{6.11}$$

$$\text{Inventory Turnover} = \frac{\$60{,}000}{\$37{,}500} = 1.6 \text{ times} \quad \textbf{6.12}$$

A ratio of 1.6 times seems to be a very low turnover rate for Clear Lake Sporting Goods. This may mean the company is maintaining too high an inventory supply to meet a low demand from customers. Managers may want to decrease their on-hand inventory to free up more liquid assets to use in other ways. Keep in mind, ratios should not be taken out of context. One ratio alone can't tell the whole story. Ratios should be used with caution and in conjunction with other ratios and additional financial and contextual information.

As with accounts receivable, there is a trade-off to consider in managing inventory. Low turnover will usually mean a low risk of stockouts and the ability to carry more of what customers are looking for. But high inventory levels will mean that more cash is tied up in inventory. High turnover will mean carrying less inventory and the higher risk of stockouts, causing customers to go elsewhere to find what they need.

**Figure 6.4** Inventory turnover can help determine how well a company manages its inventory. (credit: "Untitled" by Marcin Wichary/flickr, CC BY 2.0)

LINK TO LEARNING

### Target Corporation

As we have learned, the inventory turnover ratio shows how well a company manages its inventory. Look through the financial statements in the 2019 Annual Report for Target (https://openstax.org/r/annual-report-for-target) and calculate the inventory turnover ratio. What does the outcome mean for Target?

## Days' Sales in Inventory

Days' sales in inventory expresses the number of days it takes a company to turn inventory into sales. The fewer the number of days, the more quickly the company can sell its inventory. The greater the number of days, the longer it takes to sell its inventory. The formula for days' sales in inventory is

$$\text{Days' Sales in Inventory} = \frac{\text{Ending Inventory}}{\text{Cost of Goods Sold}} \times 365 \tag{6.13}$$

Clear Lake Sporting Goods' days' sales in inventory is

$$\text{Days' Sales in Inventory} = \frac{\$40{,}000}{\$60{,}000} \times 365 = 243 \text{ days (rounded)} \tag{6.14}$$

Depending on the industry, 243 days may be a long time to sell inventory. While industry dictates what is an acceptable number of days to sell inventory, 243 days is likely to be unsustainable long-term. Remember, it's important to not take one ratio out of context. Review the ratio in conjunction with other ratios and other financial data. For example, we might review the days' sales in inventory along with accounts receivable turnover for Clear Lake Sporting Goods relative to the industry average to get a better picture of Clear Lake's performance in this area.

# 6.3 Liquidity Ratios

By the end of this section, you will be able to:

- Calculate current, quick, and cash ratios to assess a firm's liquidity and make informed business decisions.
- Assess organizational performance using liquidity ratios.

**Liquidity** refers to the business's ability to manage current assets or convert assets into cash in order to meet short-term cash needs, another aspect of a firm's financial health. Examples of the most liquid assets include cash, accounts receivable, and inventory for merchandising or manufacturing businesses. The reason these are among the most liquid assets is that these assets will be turned into cash more quickly than land or buildings, for example. Accounts receivable represents goods or services that have already been sold and will typically be paid/collected within 30 to 45 days.

Inventory is less liquid than accounts receivable because the product must first be sold before it generates cash (either through a cash sale or sale on account). Inventory is, however, more liquid than land or buildings because, under most circumstances, it is easier and quicker for a business to find someone to purchase its goods than it is to find a buyer for land or buildings.

## Current Ratio

The **current ratio** is closely related to working capital; it represents the current assets divided by current liabilities. The current ratio utilizes the same amounts as working capital (current assets and current liabilities) but presents the amount in ratio, rather than dollar, form. That is, the current ratio is defined as current assets/current liabilities. The interpretation of the current ratio is similar to working capital. A ratio of greater than one indicates that the firm has the ability to meet short-term obligations with a buffer, while a ratio of less than one indicates that the firm should pay close attention to the composition of its current assets as well as the timing of the current liabilities.

$$\text{Current Ratio} = \frac{\text{Current Assets}}{\text{Current Liabilities}} \quad \textbf{6.15}$$

The current ratio in the current year for Clear Lake Sporting Goods is

$$\text{Current Ratio} = \frac{\$200{,}000}{\$100{,}000} = 2 \text{ or } 2{:}1 \quad \textbf{6.16}$$

A 2:1 ratio means the company has twice as many current assets as current liabilities; typically, this would be plenty to cover obligations. A 2:1 ratio is actually quite high for most companies and most industries. Again, it's recommended that ratios be used in conjunction with one another. An analyst would likely look at the high current ratio and low accounts receivable turnover to begin asking questions about management performance, as this might indicate a trouble area (high inventory and slow collections).

LINK TO LEARNING

### Target Corporation

As we have learned, the current ratio shows how well a company can cover short-term liabilities with short-term assets. Look through the balance sheet in the 2019 Annual Report for Target (https://openstax.org/r/annual-report-for-target) and calculate the current ratio. What does the outcome mean for Target?

## Quick Ratio

The **quick ratio**, also known as the *acid-test ratio*, is similar to the current ratio except current assets are more narrowly defined as the most liquid assets, which exclude inventory and prepaid expenses. The conversion of inventory and prepaid expenses to cash can sometimes take more time than the liquidation of other current assets. A company will want to know what it has on hand and can use quickly if an immediate obligation is due. The formula for the quick ratio is

$$\text{Quick Ratio} = \frac{\text{Cash} + \text{Short-Term Investments} + \text{Accounts Receivable}}{\text{Current Liabilities}} \quad \textbf{6.17}$$

The quick ratio for Clear Lake Sporting Goods in the current year is

$$\text{Quick Ratio} = \frac{\$110{,}000 + \$20{,}000 + \$30{,}000}{\$100{,}000} = 1.6 \text{ or } 1.6{:}1 \quad \textbf{6.18}$$

A 1.6:1 ratio means the company has enough quick assets to cover current liabilities. It's again key to note that a single ratio shouldn't be used out of context. A 1.6 ratio is difficult to interpret on its own. Industry averages and trend analysis for Clear Lake Sporting Goods would also be helpful in giving the ratio more meaning.

LINK TO LEARNING

Target Corporation

As we have learned, the quick ratio shows how quickly a company can liquidate current assets to cover current liabilities. Look through the financial statements in the 2019 Annual Report for Target (https://openstax.org/r/annual-report-for-target) and calculate the quick ratio. What does the outcome mean for Target?

## Cash Ratio

Cash is the most liquid asset a company has, and **cash ratio** is often used by investors and lenders to asses an organization's liquidity. It represents the firm's cash and cash equivalents divided by current liabilities and is a more conservative look at a firm's liquidity than the current or quick ratios. The ratio is reflected as a number, not a percentage. A cash ratio of 1.0 means the firm has enough cash to cover all current liabilities if something happened and it was required to pay all current debts immediately. A ratio of less than 1.0 means the firm has more current liabilities than it has cash on hand. A ratio of more than 1.0 means it has enough cash on hand to pay all current liabilities and still have cash left over. While a ratio greater than 1.0 may sound ideal, it's important to consider the specifics of the company. Sitting on idle cash is not ideal, as the cash could be used to earn a return. And having a ratio less than 1.0 isn't always bad, as many firms operate quite successfully with a ratio of less than 1.0. Comparing the company ratio with trend analysis and with industry averages will help provide more insight.

$$\text{Cash Ratio} = \frac{\text{Cash and Cash Equivalents}}{\text{Current Liabilities}} \quad \textbf{6.19}$$

The cash ratio for Clear Lake Sporting Goods in the current year is:

$$\text{Cash Ratio} = \frac{\$110{,}000}{\$100{,}000} = 1.1 \quad \textbf{6.20}$$

A 1.1 ratio means the company has enough cash to cover current liabilities.

**Figure 6.5** Cash is the most liquid asset a company has and is often used by investors and lenders to assess an organization's liquidity. (credit: "20 US Dollar" by Jack Sem/flickr CC BY 2.0)

# 6.4 Solvency Ratios

By the end of this section, you will be able to:

- Evaluate organizational solvency using the debt-to-assets and debt-to-equity ratios.
- Calculate the times interest earned ratio to assess a firm's ability to cover interest expense on debt as it comes due.

**Solvency** implies that a company can meet its long-term obligations and will likely stay in business in the future. Meeting long-term obligations includes the ability to pay any interest incurred on long-term debt. Two main solvency ratios are the debt-to-equity ratio and the times interest earned ratio.

## Debt-to-Assets Ratio

The **debt-to-assets ratio** shows the relationship between debt and assets. It reflects how much of the assets of the business was financed through debt. It reflects the company's leverage and is helpful to analysts in comparing how leveraged one company is compared to another.

Debts normally carry interest expense and must be repaid. The debt-to-assets ratio includes all debt—both long-term debt and current liabilities. The formula for the debt-to-assets ratio is

$$\text{Debt-to-Assets Ratio} = \frac{\text{Current Liabilities} + \text{Long-Term Liabilities}}{\text{Total Assets}} \quad \textbf{6.21}$$

The information needed to compute the debt-to-assets ratio for Clear Lake Sporting Goods in the current year can be found on the balance sheet. The debt-to-assets ratio for Clear Lake Sporting Goods in the current year is

$$\text{Debt-to-Assets Ratio} = \frac{\$100{,}000 + \$50{,}000}{\$250{,}000} = 0.6 \text{ or } 60\% \quad \textbf{6.22}$$

This means that 60 percent of Clear Lake's assets are financed by debt. We can also then infer that the other 40 percent is financed by equity. A ratio higher than 1.0 means the company has more debts than assets, which means it has negative equity. In Clear Lake's case, a 60 percent debt-to-assets ratio indicates some risk, but perhaps not a high risk. Comparing Clear Lake's ratio to industry averages would provide better insight.

LINK TO LEARNING

### Target Corporation

As we have learned, the debt-to-assets ratio shows the relationship between a firm's debt and assets. Look through the financial statements in the 2019 Annual Report for Target (https://openstax.org/r/annual-report-for-target) and calculate the debt-to-assets ratio. What does the outcome mean for Target?

## Debt-to-Equity Ratio

The **debt-to-equity ratio** shows the relationship between debt and equity as it relates to business financing. A company can take out loans, issue stock, and retain earnings to be used in future periods to keep operations running. A key difference in debt and equity is the interest expense repayment that a loan carries as opposed to equity, which does not have this requirement. Therefore, a company wants to know how much debt and equity contribute to its financing. The formula for the debt-to-equity ratio is

$$\text{Debt-to-Equity Ratio} = \frac{\text{Total Liabilities}}{\text{Total Stockholder Equity}} \quad \textbf{6.23}$$

The information needed to compute the debt-to-equity ratio for Clear Lake Sporting Goods in the current year can be found on the balance sheet.

$$\text{Debt-to-Equity Ratio} = \frac{\$150{,}000}{\$100{,}000} = 1.5 \text{ or } 1.5{:}1 \quad \textbf{6.24}$$

This means that for every one dollar of equity contributed toward financing, $1.50 is contributed from lenders. Recall that total assets equal total liabilities plus total equity. Both the debt-to-assets and debt-to-equity ratio have total liabilities in the numerator. The difference in the two ratios is the denominator. The denominator for the debt-to-equity ratio is total stockholder equity. The denominator for the debt-to-assets ratio is total assets, or total liabilities plus total equity. Thus, the two ratios contain the same information, making calculating both ratios redundant. A financial analyst may prefer to calculate one ratio over the other because of the format of readily available industry data to use for comparison purposes or for consistency with other calculations the analyst is performing.

THINK IT THROUGH

### Financing a Business Expansion

You are the CFO of a small corporation. The president, who is one of five shareholders, has created an innovative new product that is testing well with substantial demand. To begin manufacturing, $400,000 is needed to acquire the equipment. The corporation's balance sheet shows total assets of $2,400,000 and total liabilities of $600,000. Most of the liabilities relate to debt that carries a covenant requiring that the company maintain a debt-to-equity ratio not exceeding 0.50. Determine the effect that each of the two options of obtaining additional capital will have on the debt covenant.

**Solution:**

We know the total liabilities for the firm to be $600,000. Using the accounting equation, we can find that the firm has $1,800,000 in equity. $\$600{,}000/\$1{,}800{,}000 =$ current debt-to-equity ratio of 0.33, which is well below the requirement for the debt covenant. If the firm issues debt, the ratio changes to $\$1{,}000{,}000/\$1{,}800{,}000$, which is 0.55 and would violate the debt covenant. If the firm chooses to issue additional stock, the new debt-to-equity ratio would be $\$600{,}000/\$2{,}200{,}000$, which is 0.27. This is well below the requirements in the debt covenant.

## Times Interest Earned (TIE) Ratio

The **times interest earned (TIE) ratio** measures the company's ability to pay interest expense on all debt incurred. This ability to pay is determined by the available earnings before interest and taxes (EBIT) are deducted. These earnings are considered the operating income. Lenders will pay attention to this ratio before extending credit. The more times over a company can cover interest, the more likely a lender will extend long-term credit. The formula for times interest earned is

$$\text{Times Interest Earned} = \frac{\text{Earnings Before Interest and Taxes (EBIT)}}{\text{Interest Expense}} \quad \textbf{6.25}$$

The information needed to compute times interest earned for Clear Lake Sporting Goods in the current year can be found on the income statement.

$$\text{Times Interest Earned} = \frac{\$43{,}000}{\$2{,}000} = 21.5 \text{ times} \quad \textbf{6.26}$$

The $43,000 is the operating income, representing earnings before interest and taxes. The 21.5 times outcome suggests that Clear Lake Sporting Goods can easily repay interest on an outstanding loan and creditors would have little risk that Clear Lake Sporting Goods would be unable to pay.

LINK TO LEARNING

Times Interest Earned

This video about times interest earned (https://openstax.org/r/video-about-times) explains how to calculate it and why the ratio is useful, and it provides an example.

# 6.5 Market Value Ratios

By the end of this section, you will be able to:

- Calculate earnings per share to determine the portion of profit allocated to each outstanding share of common stock.
- Evaluate firm value using the price/earnings ratio and book value per share.

In this section we will turn our attention to **market value ratios**, measures used to assess a firm's overall market price. Common ratios used include earnings per share, the price/earnings ratio, and book value per share.

## Earnings per Share (EPS)

**Earnings per share (EPS)** measures the portion of a corporation's profit allocated to each outstanding share of common stock. An increasing earnings per share can drive up a stock price. Conversely, falling earnings per share can lower a stock's market price. Earnings per share is also a component in calculating the price-to-earnings ratio (the market price of the stock divided by its earnings per share), which many investors find to be a key indicator of the value of a company's stock.

It's key to note, however, that EPS, like any ratio, should be used with caution and in tandem with other ratios and contextual data. Many financial professionals choose not to rely on income statement data and, similarly, EPS because they feel the cash flow statement provides more reliable and insightful information.

## CONCEPTS IN PRACTICE

### Alibaba Group Earnings Announcements Continue to Exceed Market Expectations

Alibaba, a Chinese-based company traded in the United States, exceeded market expectations in 2020 quarterly earnings releases. In the November 2020 earnings release, Alibaba reported earnings per share of 17.97 yuan versus market estimates of 14.33. Despite many companies struggling due to the pandemic, Alibaba reported strong earnings as a result of the surge in online shopping and remote work.

(sources: "Alibaba Beats Estimates as Pandemic Fuels Online, Cloud Computing Demand." *CNBC.* August 20, 2020. https://www.cnbc.com/2020/08/20/alibaba-beats-quarterly-revenue-estimates.html; Emily Bary. "Alibaba Earnings Top Expectations as Pandemic Drives Increased Digital Purchases. *Market Watch.* August 20, 2020. https://www.marketwatch.com/story/alibaba-earnings-top-expectations-as-pandemic-drives-increased-digital-purchases-2020-08-20; Matthew Johnston. "Alibaba Earnings: What Happened." *Investopedia.* November 5, 2020. https://www.investopedia.com/alibaba-q2-2021-earnings-5085444; Chris Versace. "Why S&P 500 EPS Expectations Showcase the Need for Thematic Investing." *Tematica Research.* June 3, 2020. https://www.tematicaresearch.com/why-sp-500-eps-expectations-showcase-the-need-for-thematic-investing)

## Calculating Earnings per Share

Earnings per share is the profit a company earns for each of its outstanding common shares. Both the balance sheet and income statement are needed to calculate earnings per share. The balance sheet provides details on the preferred dividend rate, the total par value of the preferred stock, and the number of common shares outstanding. The income statement indicates the net income for the period. The formula to calculate basic earnings per share is

$$\text{Earnings per Share} = \frac{\text{Net Income} - \text{Preferred Dividends}}{\text{Weighted Average Common Shares Outstanding}} \quad \textbf{6.27}$$

By removing the preferred dividends from net income, the numerator represents the profit available to common shareholders. Because preferred dividends represent the amount of net income to be distributed to preferred shareholders, this portion of the income is obviously not available for common shareholders. While a number of variations of measuring a company's profit, such as NOPAT (net operating profit after taxes) and EBITDA (earnings before interest, taxes, depreciation, and amortization), are used in the financial world, GAAP requires companies to calculate earnings per share based on a corporation's net income, as this amount appears directly on a company's income statement, which for public companies must be audited.

In the denominator, only common shares are used to determine earnings per share because earnings per share is a measure of earnings for each common share of stock. The denominator can fluctuate throughout the year as a company issues and buys back shares of its own stock. The weighted average number of shares is used on the denominator because of this fluctuation. To illustrate, assume that a corporation began the year with 600 shares of common stock outstanding and then on April 1 issued 1,000 more shares. During the period January 1 to March 31, the company had the original 600 shares outstanding. Once the new shares were issued, the company had the original 600 plus the new 1,000 shares, for a total of 1,600 shares for each of the next nine months—from April 1 to December 31. To determine the weighted average shares, apply these fractional weights to both of the stock amounts (see Figure 6.6).

| Number of Shares | × | Portion of Year | = | Weighted Shares |
|---|---|---|---|---|
| 600 | × | 3/12 | = | 150 |
| 1,600 | × | 9/12 | = | 1,200 |
| Weighted Average Shares | | | | 1,350 |

**Figure 6.6 Weighted Shares**

If the shares were not weighted, the calculation would not consider the time period during which the shares were outstanding.

To illustrate how earnings per share is calculated, assume Clear Lake Sporting Goods earns $35,000 in net income during the current year. During the year, the company also declared a $5,000 dividend on preferred stock and a $6,000 dividend on common stock. The company had 8,000 common shares outstanding the entire year. Clear Lake Sporting Goods has generated $3.75 of earnings ($35,000 less the $5,000 of preferred dividends) for each of the 8,000 common shares of stock it has outstanding.

$$\text{Earnings per Share} = \frac{\$35{,}000 - \$5{,}000}{8{,}000} = \$3.75 \quad \textbf{6.28}$$

## Measuring Performance with Earnings per Share

Earnings per share is a key profitability measure that both current and potential common stockholders monitor. Its importance is accentuated by the fact that GAAP requires public companies to report earnings per share on the face of a company's income statement. This is the only ratio that requires such prominent reporting. If fact, public companies are required to report two different earnings per share amounts on their income statements—basic and diluted. We've illustrated the calculation of basic earnings per share. Diluted earnings per share, which is not demonstrated here, involves the consideration of all securities, such as stocks and bonds, that could potentially dilute, or reduce, the basic earnings per share.

### LINK TO LEARNING

#### Finding Earning per Share for Public Companies

Where can you find earnings per share information on public companies? Use the Yahoo! Finance (https://openstax.org/r/yahoo-finance) website to look up stock and earnings per share data for Tellurian Inc. (TELL), Amazon (AMZN), or CVS Pharmacy (CVS). Or use the search function to search for earnings per share data for your favorite corporation. Enter the ticker for the company you are looking up, and a basic chart and graph will display with stock price data along with several commonly used ratios (including earnings per share).

As you review data, keep in mind that a company can manipulate or impact its earnings per share by issuing new shares or buying back issued shares. What are the ethical implications of earnings per share calculations?

Common stock shares are normally purchased by investors to generate income through dividends or to sell at a profit in the future. Investors realize that inadequate earnings per share can result in poor or inconsistent dividend payments and fluctuating stock prices. As such, companies seek to produce earnings per share amounts that rise each period. However, an increase in earnings per share may not always reflect favorable performance, as there are multiple reasons that earnings per share may increase. One way earnings per share can increase is through increased net income. On the other hand, it can also increase when a company buys back its own shares of stock.

For example, assume that Clear Lake Sporting Goods generated net income of $30,000 and paid out $3,000 in preferred shareholder dividends last year. In addition, 10,550 shares of common stock were outstanding throughout the entire year. In January of the current year, the company buys back shares of its common stock and holds them as treasury shares, making its current weighted average shares outstanding for this year 8,000. Net income for the current year is $35,000, $5,000 of which was paid to preferred shareholders in dividends. In the prior year, the company's earnings per share was

$$\text{Earnings per Share} = \frac{\$30{,}000 - \$3{,}000}{10{,}550} = \$2.56 \quad \textbf{6.29}$$

Clear Lake Sporting Goods' current year earnings per share is

$$\text{Earnings per Share} = \frac{\$35{,}000 - \$5{,}000}{8{,}000} = \$3.75 \quad \textbf{6.30}$$

The purchase of treasury stock in the current year reduces the common shares outstanding to 8,000 because treasury shares are considered issued but not outstanding. Earnings per share for the current year is now $3.75 per share even though earnings only increased by $5,000. It's key to note the impact of purchasing treasury stock and the intentions in doing so. Treasury stock is commonly purchased for a variety of reasons, but doing so to intentionally manipulate earnings per should not be a primary reason.

This increase in earnings per share occurred because the net income is now spread over fewer shares of stock. Similarly, earnings per share can decline even when a company's net income increases if the number of shares increases at a higher degree than net income.

## CONCEPTS IN PRACTICE

### Stock Buybacks Can Drive Up Earnings per Share: Ethical?

As many companies struggled to make ends meet or meet their cash flow needs amid the COVID-19 pandemic, some companies continued to thrive. Apple continued to have a healthy financial position with ample cash supply. It repurchased $18.5 billion of its own stock in the second quarter of 2020.[1] The total stock buyback over the preceding five years was $282.87 billion, which is 3.5 times higher than any other company. Since the earnings per share calculation is earnings divided by average outstanding shares, the fewer shares there are outstanding, the higher earnings per share goes without the firm having to actually raise earnings.

What do you think? Did Apple act ethically in repurchasing large quantities of its own shares? Is it ethical for any company to do so? If you were an investor or analyst, what questions would you ask or what cautions would you take in assessing and comparing earnings per share data?

(sources: Wayne Duggan. "7 S&P 500 Companies with Stock Buybacks." *US News & World Report.* December 14, 2020. https://money.usnews.com/investing/stock-market-news/slideshows/s-p-500-companies-with-stock-buybacks?slide=2; "Apple's $460 Billion Stock Buyback." *Above Avalon.* April 23, 2020. https://www.aboveavalon.com/notes/2020/4/23/apples-460-billion-stock-buyback; "Apple Stock Buybacks (Quarterly)." *Ycharts.* n.d. https://ycharts.com/companies/AAPL/stock_buyback)

## LINK TO LEARNING

### Stock Buybacks

This *Wall Street Journal* video about stock buybacks (https://openstax.org/r/video-about-stock-buybacks) explains the various perspectives on the subject. It walks through the basic concepts of how buybacks work and explores some viewpoints on whether buybacks are good, bad, or otherwise.

To put a firm's earnings per share into perspective and allow for a more meaningful analysis, earnings per share is often tracked over a number of years, such as when presented in the comparative income statements for Clear Lake Sporting Goods (see Figure 6.7).

1 Bill Maurer. "Apple: New Highs Seem Likely." Seeking Alpha. May 11, 2020. https://seekingalpha.com/article/4346246-apple-new-highs-seem-likely

| Clear Lake Sporting Goods<br>Comparative Year-End Income Statements | | | |
|---|---|---|---|
| | **Current Year** | **Prior Year** | **2 Years Prior** |
| Net Sales | $120,000 | $100,000 | $90,000 |
| Cost of Goods Sold | 60,000 | 50,000 | 45,000 |
| Gross Profit | 60,000 | 50,000 | 45,000 |
| Rent Expense | 5,500 | 5,000 | 5,000 |
| Depreciation Expense | 3,600 | 2,500 | 2,000 |
| Salaries Expense | 5,400 | 3,000 | 2,750 |
| Utility Expense | 2,500 | 1,500 | 1,250 |
| Operating Income | 43,000 | 38,000 | 34,000 |
| Interest Expense | 2,000 | 3,000 | 2,000 |
| Income Tax Expense | 6,000 | 5,000 | 5,000 |
| Net Income | $ 35,000 | $ 30,000 | $27,000 |
| | | | |
| Basic Weighted Shares Outstanding | 8,000 | 10,550 | 11,100 |
| Basic Net Income per Share (EPS) | $ 3.75 | $ 2.56 | $ 2.21 |
| Common Dividends | $ 6,000 | $ 4,000 | $ 3,500 |
| Preferred Dividends | $ 5,000 | $ 3,000 | $ 2,500 |

**Figure 6.7 Comparative Year-End Income Statements** Earnings per share year after year can be a good indication of a company's financial health.

Most analysts believe that a consistent improvement in earnings per share year after year is an indication of continuous improvement in the earning power of a company. This is what is seen in Clear Lake Sporting Goods' earnings per share amounts over each of the three years reported, moving from $2.21 to $2.56 to $3.75. However, it is important to remember that earnings per share is calculated on historical data, which is not always predictive of the future.

### THINK IT THROUGH

#### Would You Have Invested?

What if, in 1997, you invested $5,000 in Amazon? Today, your investment would be worth nearly $6 million. Potential investors viewing Amazon's income statement in 1997 would have seen earnings per share of negative $1.27. In other words, Amazon lost $1.27 for each share of common stock outstanding. Would you have invested?

**Solution:**

Answers will vary. A strong response would include the idea that a negative or small earnings per share reflects upon the historical operations of a company. Earnings per share does not predict the future. Investors in 1997 looked beyond Amazon's profitability and saw its business model having strong future potential.

## Price/Earnings (P/E) Ratio

The **price/earnings (P/E) ratio** measures the current market share price of a company's stock relative to its earnings per share (EPS). The ratio is helpful in comparing performance and stock price of a company to other companies. It's also helpful in evaluating how much investors are willing to pay for earnings performance. Investors, in particular, use this ratio and rely on two key characteristics: past performance (trailing) and future estimates (forward). Trailing data can be calculated but is also easily found online, as it's a common measure reported on financial sites. Investors will often look for P/E TTM, which is the price/earnings ratio for the trailing 12 months (last year worth of earnings data). This helps investors assess one day's stock price relative to the earnings per share over the past 12 months. P/E ratio is widely used by investors to determine if a stock is over- or undervalued. It also helps them compare one firm to that of the industry average or index, such as the S&P 500.

$$\text{Price/Earnings Ratio} = \frac{\text{Market Value per Share}}{\text{Earnings per Share}} \quad \textbf{6.31}$$

In the prior section we saw earnings per share data for Clear Lake Sporting Goods. Using its current year earnings per share of $3.75 and the current stock price of $69.41, we can calculate price/earnings ratio for Clear Lake Sporting Goods:

$$\text{Price Earnings Ratio} = \frac{\$69.41}{\$3.75} = 18.51 \quad \textbf{6.32}$$

An 18.51 ratio means an investor would expect to invest $18.51 to gain $1 of earnings.

## Book Value per Share

**Book value per share** is often used hand in hand with market value per share. Investors compare the two in order to see if the stock is possibly over- or undervalued. Book value is derived from accounting practices and shows the value of the firm on paper. Market value, on the other hand, is determined by supply and demand, based on what investors are willing to pay for the stock. If the market value per share is higher than the book value, the stock is considered overvalued. If the market value is lower than the book value, it's considered undervalued.

In theory, book value per share represents the total value common shareholders would receive if the firm were liquidated. It is total equity less preferred equity, spread across the total shares outstanding. The formula to calculate book value per share is

$$\text{Book Value per Share} = \frac{\text{Total Equity} - \text{Preferred Equity}}{\text{Total Shares Outstanding}} \quad \textbf{6.33}$$

The book value per share for Clear Lake Sporting Goods is

$$\text{Book Value per Share} = \frac{\$100{,}000 - \$20{,}000}{8{,}000} = \$10 \quad \textbf{6.34}$$

If investors compared the book value per share of $10.00 for Clear Lake Sporting Goods to the P/E ratio of $18.51, they would likely conclude that the stock was undervalued in the year of analysis.

LINK TO LEARNING

### Book Value versus Market Value of Shares

This video about book value and market value (https://openstax.org/r/video-about-book-value) explains the basic concepts and discusses how the two differ. Samples of the concept are then explored using Apple Inc. as an example.

# 6.6 Profitability Ratios and the DuPont Method

By the end of this section, you will be able to:

- Calculate profit margin to determine how much sales revenues the firm has translated into income.
- Evaluate firm performance by calculating return on total assets and return on equity.
- Analyze organizational performance using DuPont method calculations.

Profitability considers how well a company produces returns given its operational performance. The company needs to use its assets and operations efficiently to increase profit. To assist with profit goal attainment, company revenues need to outweigh expenses. Let's consider three profitability measurements and ratios: profit margin, return on total assets, and return on equity.

## Profit Margin

**Profit margin** represents how much of sales revenue has translated into income. This ratio shows how much of each $1 of sales is returned as profit. The larger the ratio figure (the closer it gets to 1), the more of each sales dollar is returned as profit. The portion of the sales dollar not returned as profit goes toward expenses. The formula for profit margin is

$$\text{Profit Margin} = \frac{\text{Net Income}}{\text{Net Sales}} \tag{6.35}$$

For Clear Lake Sporting Goods, the profit margin in the current year is

$$\text{Profit Margin} = \frac{\$35{,}000}{\$120{,}000} = 0.29 \text{ (rounded) or } 29\% \tag{6.36}$$

This means that for every dollar of sales, $0.29 returns as profit. If Clear Lake Sporting Goods thinks this is too low, the company would try to find ways to reduce expenses and increase sales.

## Return on Total Assets

The **return on total assets** measures the company's ability to use its assets successfully to generate a profit. The higher the return (ratio outcome), the more profit is created from asset use. Average total assets are found by dividing the sum of beginning and ending total assets balances found on the balance sheet. The beginning total assets balance in the current year is taken from the ending total assets balance in the prior year. The formula for return on total assets is

$$\text{Return on Total Assets} = \frac{\text{Net Income}}{\text{Average Total Assets}} \tag{6.37}$$

$$\text{Average Total Assets} = \frac{(\text{Beginning Total Assets} + \text{Ending Total Assets})}{2} \tag{6.38}$$

For Clear Lake Sporting Goods, the return on total assets for the current year is

$$\text{Average Total Assets} = \frac{(\$200{,}000 + \$250{,}000)}{2} = \$225{,}000 \tag{6.39}$$

$$\text{Return on Total Assets} = \frac{\$35{,}000}{\$225{,}000} = 0.16 \text{ (rounded) or } 16\% \tag{6.40}$$

The higher the figure, the better the company is using its assets to create a profit. Industry standards can dictate what an acceptable return is.

LINK TO LEARNING

### Return on Assets

This video explains how to calculate return on assets (https://openstax.org/r/video-explains-how-to-calculate) and how to interpret the results. The video provides the formula, a discussion of the concept, and the importance of the ratio.

## Return on Equity

**Return on equity** measures the company's ability to use its invested capital to generate income. The invested capital comes from stockholders' investments in the company's stock and its retained earnings and is leveraged to create profit. The higher the return, the better the company is doing at using its investments to yield a profit. The formula for return on equity is

$$\text{Return on Equity} = \frac{\text{Net Income}}{\text{Average Stockholder Equity}} \quad \textbf{6.41}$$

$$\text{Average Stockholder Equity} = \frac{\text{Beginning Stockholder Equity} + \text{Ending Stockholder Equity}}{2} \quad \textbf{6.42}$$

Average stockholders' equity is found by dividing the sum of beginning and ending stockholders' equity balances found on the balance sheet. The beginning stockholders' equity balance in the current year is taken from the ending stockholders' equity balance in the prior year. Keep in mind that the net income is calculated after preferred dividends have been paid.

For Clear Lake Sporting Goods, we will use the net income figure and deduct the preferred dividends that have been paid. The return on equity for the current year is

$$\text{Average Stockholder Equity} = \frac{90{,}000 + 100{,}000}{2} = 95{,}000 \quad \textbf{6.43}$$

$$\text{Return on Equity} = \frac{\$35{,}000 - \$5{,}000}{\$95{,}000} = 0.32 \text{ (rounded) or } 32\% \quad \textbf{6.44}$$

The higher the figure, the better the company is using its investments to create a profit. Industry standards can dictate what an acceptable return is.

## The DuPont Method

ROE in its basic form is useful; however, there are really three components of ROE: operating efficiency (profit margin), asset usage (total asset turnover), and leverage (equity ratio). This is known as the **DuPont method**. It originated in 1919 when the DuPont company implemented it for internal measurement purposes.[2] The DuPont method can be expressed using this formula:

$$\text{ROE} = \text{Profit Margin} \times \text{Total Asset Turnover} \times \text{Equity Multiplier} \quad \textbf{6.45}$$

Profit margin indicates how much profit is generated by each dollar of sales and is computed as shown:

$$\text{Profit Margin} = \frac{\text{Net Income}}{\text{Net Sales}} \quad \textbf{6.46}$$

Total asset turnover indicates the number of sales dollars produced by every dollar invested in capital assets—in other words, how efficiently the company is using its capital assets to generate sales. It is computed as shown:

$$\text{Total Asset Turnover} = \frac{\text{Net Sales}}{\text{Total Assets}} \quad \textbf{6.47}$$

The equity multiplier measures leverage. It is computed as shown:

$$\text{Equity Multiplier} = \frac{\text{Average Total Assets}}{\text{Average Stockholders' Equity}} \quad \textbf{6.48}$$

Using DuPont analysis, investors can see overall performance broken down into smaller pieces, which helps them better understand what is driving ROE. We already have the computations for Clear Lake Sporting Goods' profit margin and total asset turnover:

$$\text{Profit Margin} = \frac{\$35{,}000}{\$120{,}000} = 0.29 \text{ (rounded) or } 29\% \quad \textbf{6.49}$$

$$\text{Total Asset Turnover} = \frac{\$120{,}000}{\$225{,}000} = 0.53 \text{ times (rounded)} \quad \textbf{6.50}$$

We can calculate the equity multiplier using the equity multiplier equation and prior calculations for Clear

2 Joshua Kennon. "What Is the DuPont Method Return on Equity, or ROE, Formula?" The Balance. December 16, 2020. https://thebalance.com/the-dupont-model-return-on-equity-formula-for-beginners-357494

Lake's average total assets and average stockholder equity:

$$\text{Equity Multiplier} = \frac{\text{Average Total Assets}}{\text{Average Stockholders' Equity}} \quad \textbf{6.51}$$

$$\text{Average Total Assets} = \frac{\$200{,}000 + \$250{,}000}{2} = \$225{,}000 \quad \textbf{6.52}$$

$$\text{Average Stockholder Equity} = \frac{\$90{,}000 + \$100{,}000}{2} = \$95{,}000 \quad \textbf{6.53}$$

$$\text{Equity Multiplier} = \frac{\$225{,}000}{\$95{,}000} = 2.37 \quad \textbf{6.54}$$

Now that we have all three elements, we can complete the DuPont analysis for Clear Lake Sporting Goods:

$$\text{ROE} = \text{Profit Margin} \times \text{Total Asset Turnover} \times \text{Equity Multiplier} \quad \textbf{6.55}$$

$$\text{ROE} = 29\% \times 0.53 \times 2.37 = 0.36 \text{ or } 36.4\% \quad \textbf{6.56}$$

LINK TO LEARNING

### The DuPont Method

This video about the DuPont method (https://openstax.org/r/video-about-DuPont-method) walks through its history, discusses its basic components, and shows how to calculate and interpret each measurement.

## Performance Analysis

ROE captures the nuances of all three elements. A good sales margin and a proper asset turnover are both needed for a successful operation. Like all ratios, assessing performance is relative. It's important to look at the ratio in context of the organization, its history, and the industry. If we compare Clear Lake's ROE of 26.4% to the recreational products industry average of 12.56% for the same year, it would appear as though Clear Lake Sporting Goods is outperforming the general industry. However, recreational products can include a wide variety of businesses beyond just the outdoor gear in which Clear Lake Sporting Goods specializes. An analyst could look at other key competitors such as Cabela's or Bass Pro Shops to get even more relevant comparisons.

Clear Lake Sporting Goods is also technically a retail store, albeit a specialized one. An analyst might also consider the industry averages for general or online retail of 20.64% and 27.05%, respectively. Compared to the broader retail industry, Clear Lake Sporting Goods is still performing well, but its performance is not as disparate to industry average as when compared to recreational products (see Table 6.1).

| Industry | ROE (%) |
|---|---|
| Advertising | 2.93 |
| Air Transportation | −47.03 |
| Computer Services | 13.50 |
| Banking | 8.22 |
| Financial Services (nonbanking) | 64.28 |
| Food Processing | 10.12 |
| Renewable Energy | −20.59 |

**Table 6.1 Return on Equity by Industry in 2020** It's important to look at any ratio in context of the organization, its history, and the industry. (data source: Aswath Damodaran Online)

| Industry | ROE (%) |
|---|---|
| Hospitals/Health Care Facilities | 70.64 |
| Hotels/Gaming | −30.40 |
| Publishers | −14.18 |
| Recreational Products | 12.56 |
| Real Estate (general) | 2.00 |
| Retail: | 0.00 |
| Automotive | 36.28 |
| Building Supply | 0.27 |
| General | 20.64 |
| Grocery | 30.63 |
| Online | 27.05 |
| Rubber and Tires | −26.69 |
| Shoes | 23.70 |
| Software (systems and applications) | 28.09 |
| Transportation | 21.47 |
| Total Market Average | 8.25 |

**Table 6.1 Return on Equity by Industry in 2020** It's important to look at any ratio in context of the organization, its history, and the industry. (data source: Aswath Damodaran Online)

# Summary

## 6.1 Ratios: Condensing Information into Smaller Pieces

Ratios used in financial analysis can help investors and other analysts identify trends over time, compare companies to one another, and make informed decisions about a company. There are, however, limitations to analysis, so it should be used wisely and in conjunction with other contextual information available.

## 6.2 Operating Efficiency Ratios

Efficiency ratios measure how well management uses the assets of the organization to earn a profit. Common efficiency ratios include accounts receivable turnover, total asset turnover, inventory turnover, and days' sales in inventory.

## 6.3 Liquidity Ratios

Liquidity ratios help analysts measure how well an organization can meet its short-term obligations (liabilities) as they come due. Common ratios to measure liquidity include the current ratio, the quick ratio, and the cash ratio. Each of these three ratios includes more (cash ratio) or less liquid (current ratio) current assets in its measure of liquidity.

## 6.4 Solvency Ratios

Solvency ratios measure how well an organization can meet its long-term obligations (liabilities) as they come due, or in more general terms, its ability to stay in business. Common solvency ratios include the debt-to-assets ratio and the debt-to-equity ratio.

## 6.5 Market Value Ratios

Market value ratios help analysts assess the value of publicly traded firms in the market. The most commonly used market value ratios include earnings per share (EPS), the price/earnings ratio, and book value per share.

## 6.6 Profitability Ratios and the DuPont Method

Profitability ratios help measure how effectively the organization earns a profit. Common profitability ratios include profit margin, return on total assets, and return on equity. The DuPont method breaks down return on equity into three smaller components for a more thorough assessment of performance: profit margin, total asset turnover, and an equity multiplier.

# Key Terms

**accounts receivable turnover ratio** measures how many times in a period (usually a year) a company will collect cash from accounts receivable

**book value per share** total book value (assets – liabilities) of a firm expressed on a per-share basis

**cash ratio** represents the firm's cash and cash equivalents divided by current liabilities; often used by investors and lender to assess an organization's liquidity

**current ratio** current assets divided by current liabilities; used to determine a company's liquidity (ability to meet short-term obligations)

**days' sales in inventory** the number of days it takes a company to turn inventory into sales

**debt-to-assets ratio** measures the portion of debt used by a company relative to the amount of assets

**debt-to-equity ratio** measures the portion of debt used by a company relative to the amount of stockholders' equity

**DuPont method** framework for financial analysis that breaks return on equity down into smaller elements

**earnings per share (EPS)** measures the portion of a corporation's profit allocated to each outstanding share of common stock

**efficiency ratios** ratios that show how well a company uses and manages its assets

**inventory turnover** measures the number of times an average quantity of inventory was bought and sold during the period
**liquidity** ability to convert assets into cash in order to meet primarily short-term cash needs or emergencies
**market value ratios** measures used to assess a firm's overall market price
**operating cycle** amount of time it takes a company to use its cash to provide a product or service and collect payment from the customer
**price/earnings (P/E) ratio** company's stock price divided by the company's earnings per share; indicates the amount investors are willing to pay for one dollar of earnings
**profit margin** represents how much of sales revenue has translated into income
**quick ratio** also known as the *acid test ratio*; ratio used to determine a firm's ability to pay short-term debts using its most liquid assets
**return on equity** measures the company's ability to use its invested capital to generate income
**return on total assets** measures the company's ability to use its assets successfully to generate a profit
**solvency** implies that a company can meet its long-term obligations and will likely stay in business in the future
**times interest earned (TIE) ratio** measures the company's ability to pay interest expense on long-term debt incurred
**total asset turnover** measures the ability of a company to use its assets to generate revenues

## CFA Institute

This chapter supports some of the Learning Outcome Statements (LOS) in this CFA® Level I Study Session (https://openstax.org/r/cfa-study-session11). Reference with permission of CFA Institute.

## Multiple Choice

1. Which of the following is financial statement analysis not used for?
   **a.** identifying trends over time
   **b.** benchmarking against other firms
   **c.** complying with SEC (Securities and Exchange Commission) regulations
   **d.** setting budget expectations

2. How is converting financial data to percentages helpful in financial analysis?
   **a.** It makes the figures easier to calculate.
   **b.** It masks actual financial data so the competition can't see it.
   **c.** It saves time.
   **d.** It makes comparisons to companies of varying sizes possible.

3. What is a common economic influence that has the potential to skew financial analysis figures?
   **a.** past performance
   **b.** inflation
   **c.** Generally Accepted Accounting Principles
   **d.** benchmark data

4. What is the formula for accounts receivable turnover?
   **a.** net credit sales / average accounts receivable
   **b.** total sales / average accounts receivable
   **c.** net credit sales / beginning accounts receivable
   **d.** net cash sales / ending accounts receivable

5. What is the formula for the times interest earned ratio?
   **a.** net income / interest expense
   **b.** earnings before interest and taxes / interest expense

**c.** interest expense / earnings before interest and taxes
**d.** earnings before interest and taxes – interest expense

6. What is the formula for the calculation of earnings per share?
   **a.** (net income + preferred dividends) / weighted average common shares outstanding
   **b.** net income / weighted average common shares outstanding
   **c.** (net income – preferred dividends) / weighted average common shares outstanding
   **d.** (net income – preferred dividends) / treasury shares outstanding

7. Most analysts believe which of the following is true about earnings per share?
   **a.** Consistent improvement in earnings per share year after year is an indication of continuous improvement in the company's earning power.
   **b.** Consistent improvement in earnings per share year after year is an indication of continuous decline in the company's earning power.
   **c.** Consistent improvement in earnings per share year after year is an indication of fraud within the company.
   **d.** Consistent improvement in earnings per share year after year is an indication that the company will never suffer a year of net loss rather than net income.

8. What is the formula for profit margin?
   **a.** net sales / net income
   **b.** cost of goods sold / net sales
   **c.** sales / cost of goods sold
   **d.** net income / net sales

## Review Questions

1. Is past performance considered a good indicator of future performance?
2. The Pony Parts Tack Shop had inventory turnover of 12.8, 12.2, and 9.9 over the last three years, respectively. What can you learn about how well the Pony Parts management team is managing their inventory using this information?
3. The Pony Parts Tack Shop had total asset turnover of 1.8., 2.1, and 2.4 over the last three years, respectively. What can you learn about how well the Pony Parts management team is managing their total assets using this information?
4. Big Box Store Inc. had days' sales in inventory of 30, 32, and 34 for the last three years. Small Box Store Inc. had days' sales in inventory of 40, 38, and 36 for the last three years. What can you infer about the inventory management for the two companies based on this information? Which company is performing better?
5. Jackson's Beef Jerky Shop has a current ratio of 2.35. What does that mean? Is 2.35 a good or bad current ratio?
6. Jackson's Beef Jerky Shop has a quick ratio of 1.9. What does that mean? Is 1.9 a good or bad quick ratio?
7. Jackson's Beef Jerky Shop has a cash ratio of 1.75. What does that mean? Is 1.75 a good or bad cash ratio?
8. You have some funds that you would like to invest. Do some internet research to find two publicly traded companies in the same industry and compare their earnings per share. Would the earnings per share reported by each company influence your decision in selecting which company to invest in?
9. Company A has a market value per share of 19.55 and book value per share of 12.79. If you were an investor, what would you conclude about the current value of Company A stock?
10. Company B has a price/earnings ratio of 21.2. The current industry average price/earnings ratio is 20.75.

What might an investor conclude about investing in Company B?

11. What are the key elements of the DuPont formula, and how do these components function to help analysts assess an organization?

## Problems

1. Sarah's Toy Shop has total sales of $100,000, net credit sales of $70,000, beginning accounts receivable of $20,000, and ending accounts receivable of $30,000. What is Sarah's accounts receivable turnover? Assume industry average is 2.9 times. How would you interpret Sarah's turnover?
2. Fantastic Foods has total assets of $150,000, current assets of $80,000 (current assets includes $30,000 of cash, $10,000 of short term investments, $20,000 of accounts receivable, and $20,000 of inventory), total liabilities of $120,000, and current liabilities of $70,000. What is Fantastic Foods' current ratio?
3. The Big Club has total assets of $150,000, current assets of $80,000 (current assets includes $30,000 of cash, $10,000 of short-term investments, $20,000 of accounts receivable, and $20,000 of inventory), total liabilities of $120,000, and current liabilities of $70,000. What is The Big Club's quick ratio?
4. Giant Sales has total assets of $150,000, current assets of $80,000 (current assets includes $30,000 of cash, $10,000 of short-term investments, $20,000 of accounts receivable, and $20,000 of inventory), total liabilities of $120,000, and current liabilities of $70,000. What is Giant Sales' cash ratio?
5. Bonita's Bread Company has total debt of $250,000 and total assets of $150,000. What is Bonita's debt-to-assets ratio, and what can we infer about Bonita's company using the ratio?
6. Jai Company has total liabilities of $200,000 and total stockholder equity of $300,000. What is the debt-to-equity ratio for Jai Company, and what can we infer about the firm using this ratio?
7. Jamilah's Manufacturing Company has earnings before interest and taxes of $29,000 and interest expense of $4,000 for the most current period. What is Jamilah's times interest earned ratio?
8. Sarai's Sandy Beach Gear has net sales of $100,000, cost of goods sold of $60,000, and net income of $25,000. What is Sarai's profit margin?
9. Bob's Tires Inc. has sales of $100,000, net income of $50,000, beginning asset balance of $200,000, ending asset balance of $220,000, beginning stockholder equity of $160,000, and ending stockholder equity of $200,000. What is Bob's return on total assets?
10. Bob's Tires Inc. has sales of $100,000, net income of $50,000, beginning asset balance of $200,000, ending asset balance of $220,000, beginning stockholder equity of $160,000, and ending stockholder equity of $200,000. What is Bob's return on equity?

## Video Activity

### Ratio Analysis—Limitations of Ratios

Access multimedia content (http://openstax.org/books/principles-finance/pages/6-video-activity)

1. In the video, Jim walks through several key limitations in the areas of reliability, comparability, relying on only one data source, and using information based in the past. Which limitation do you feel is the most worrisome? What might you do to compensate for the limitation you identified?
2. Outside of the four key areas of limitations, Jim also explores a number of key elements that ratios aren't able to convey. What characteristics of a firm would you most want to know about if you were to invest that you would not be able to glean from ratios? How would you go about gathering that information if you cannot get it through financial statements and ratio analysis?

## The Problem with Earnings per Share (EPS)

Access multimedia content (http://openstax.org/books/principles-finance/pages/6-video-activity)

3. What does Zach DeGregorio cite as the most beneficial characteristics of using EPS in financial analysis? And the most problematic?
4. After watching the video and listing the key benefits and problems with EPS, how do you feel about the EPS calculation? Should investors use it? Why or why not? If you were going to invest a large sum of money in a company, would you use EPS data in your decision-making process? Why or why not?

7

# Time Value of Money I: Single Payment Value

**Figure 7.1** Time has an impact on the value of money. (credit: modification of "Time is money" by Marco Verch/flickr, CC BY 2.0)

## Chapter Outline

**7.1** Now versus Later Concepts
**7.2** Time Value of Money (TVM) Basics
**7.3** Methods for Solving Time Value of Money Problems
**7.4** Applications of TVM in Finance

## Why It Matters

One of the single most important concepts in the study of finance is the time value of money (TVM). This concept puts forward the idea that a dollar received today is worth more than, and therefore preferable to, a dollar received at some point in the future. The three primary reasons for this are that (1) money received now can be saved or invested now and earn interest or a return, resulting in more money in the future; (2) any promise of future payments of cash will always carry the risk of default; and (3) it is simple human nature for people to prefer making their purchases of goods and services in the present rather than waiting to make them at some future time.

For this reason, it is important to incentivize people to give up their present consumption patterns by offering them greater value in the future. Based on the concept of TVM, it can be said that a dollar was worth more to us, and thus carried more value, yesterday than it is to us today. It also then follows that a dollar in our possession right now carries a greater value for us than a dollar we might receive tomorrow or at some other point in the future.

The entire concept of the time value of money is particularly important because it allows savers and investors to make better-informed decisions about what to do with their money. TVM can help a person understand which option may be best based on the critical factors of overall risk, rates of interest, inflation, and return. TVM can also be used to help a person understand how much money they'll need to save in an interest-bearing account in order to reach a desired financial goal, such as saving $50,000 in 10 years in an account that earns 4% compound interest each year. TVM is the key underlying principle of such important financial analytical activities as retirement planning, corporate capital project evaluation, and even deciding on your

own personal investments and bank accounts.

If the main concept behind the TVM is that a specific amount of money in hand now is worth more today than that same amount of money will be worth tomorrow, you might think that a person would be better off spending their money now rather than saving it for later use. However, we know that this is not always the case. Sometimes it is simply a better idea to save your money. While inflation can have the effect of making a dollar worth less tomorrow than it is worth today, the positive effect of compound interest works in favor of savers and investors.

# 7.1 Now versus Later Concepts

## Learning Outcomes

By the end of this section, you will be able to:

- Explain why time has an impact on the value of money.
- Explain the concepts of future value and present value.
- Explain why lump sum cash flow is the basis for all other cash flows.

## How and Why the Passage of Time Affects the Value of Money

The concept of the **time value of money (TVM)** is predicated on the fact that it is possible to earn **interest** income on cash that you decide to deposit in an **investment** or interest-bearing account. As times goes by, interest is earned on amounts you have invested (*present value*), which effectively means that time will add value (*future value*) to your savings. The longer the period of time you have your money invested, the more interest income will accrue. Also, the higher the rate of interest your account or investment is earning, again, the more your money will grow.

Understanding how to calculate values of money in the present and at different points in the future is a key component of understanding the material presented in this chapter—and of making important personal financial decisions in your future (see Figure 7.2).

**Money in Deposit Account Earning Interest**

**Figure 7.2 The Time Value of Money** It is better to be paid today, or you will lose out on the money you would have earned in interest.

## The Lump Sum Payment or Receipt

The most basic type of financial transaction involves a simple, one-time amount of cash, which can be either a receipt (inflow) or a payment (outflow). Such a one-time transaction is typically referred to as a lump sum. A lump sum consists of a one-off cash flow that occurs at any single point in time, present or future. Because it is always possible to dissect more complex transactions into smaller parts, the lump sum cash flow is the basis on which all other types of cash flow are treated. According to the general principle of adding value, every type of cash flow stream can be divided into a series of lump sums. For this reason, it is critical to understand the math associated with lump sums if you wish to have a greater appreciation, and a complete understanding, of

more complicated forms of cash flow that may be associated with an investment or a capital purchase by a company.

# 7.2 Time Value of Money (TVM) Basics

## Learning Outcomes

By the end of this section, you will be able to:

- Define *future value* and provide examples.
- Explain how future dollar amounts are calculated using a single-period scenario.
- Describe the impact of compounding.

Because we can invest our money in interest-bearing accounts and investments, its value can grow over time as interest income accrues or returns are realized on our investments. This concept is referred to as **future value (FV)**. In short, future value refers to how a specific amount of money today can have greater value tomorrow.

## Single-Period Scenario

Let us start with the following example. Your friend is considering putting money in a bank account that will pay 4% interest per year and is particularly interested in knowing how much money they will have one year from now if they deposit $1,000 in this account. Your friend understands that you are studying finance and turns to you for help. By using the TVM principle of future value (FV), you can tell your friend that the answer is $1,040. The additional $40 that will be in the account after one year will be due to interest earned over that time. You can calculate this amount relatively easily by taking the original deposit (also referred to as the principal) of $1,000 and multiplying it by the annual interest rate of 4% for one period (in this case, one year).

$$\text{Interest Earned} = \$1{,}000 \times 0.04 = \$40.00 \tag{7.1}$$

By taking the interest earned amount of $40 and adding it to the original principal of $1,000, you will arrive at a total value of $1,040 in the bank account at the end of the year. So, the $1,040 one year from today is equal to $1,000 today when working with a 4% earning rate. Therefore, based on the concept of TVM, we can say that $1,040 represents the future value of $1,000 one year from today and at a 4% rate of interest. We will discuss interest rates and their importance in TVM decisions in more detail later in this chapter; for now, we can consider interest rate as a percentage of the principal amount that is earned by the original lender of funds and/or charged to the borrower of these same funds. Following are a few more examples of the single-period scenario.

If a person deposits $300 in an account that pays 5% per year, at the end of one year, they will have

$$\text{FV} = \$300 + (\$300 \times 0.05) = \$315 \tag{7.2}$$

If a company has earnings of $2.50 per share and experiences a 10% increase in the following year, the earnings per share in year two are

$$\$2.50 + \$2.50 \times 0.10 = \$2.75 \text{ per share} \tag{7.3}$$

If a retail store decides on a 3% price increase for the following year on an item that is currently selling for $50, the new price in the following year will be

$$\$50 + \$50 \times 0.03 = \$51.50 \tag{7.4}$$

## The Impact of Compounding

What would happen if your friend were willing to wait one more year to receive their lump sum payment? What would the future dollar value in their account be after a two-year period? Returning to our earlier example, assume that during the second year, your friend leaves the principal ($1,000) and the earned interest ($40) in the account, thereby reinvesting the entire account balance for another year. The quoted interest rate

of 4% reflects the interest the account would earn each year, not over the entire two-year savings period. So, during the second year of savings, the $1,000 deposit and the $40 interest earned during the first year would both earn 4%:

$$\$1{,}000 \times 0.04 + 40 \times 0.04 = \$41.60 \quad \textbf{7.5}$$

The additional $1.60 is interest on the first year's interest and reflects the compounding of interest. *Compound interest* is the term we use to refer to interest income earned in subsequent periods that is based on interest income earned in prior periods. To put it simply, compound interest refers to interest that is earned on interest. Here, it refers to the $1.60 of interest earned in the second year on the $40.00 of interest earned in the first year. Therefore, at the end of two years, the account would have a total value of $1,081.60. This consists of the original principal of $1,000 plus the $40.00 interest income earned in year one and the $41.60 interest income earned in year two.

The amount of money your friend would have in the account at the end of two years, $1,081.60, is referred to as the future value of the original $1,000 amount deposited today in an account that will earn 4% interest every year.

Simple interest applies to year 1 while compound interest or "interest on interest" applies to year 2. This is calculated using the following method:

$$\begin{aligned} \text{Year 1:} \quad & 1{,}000 \times 0.04 = 40.00 \\ \text{Year 2:} \quad & 1{,}040 \times 0.04 = 41.60 \end{aligned} \quad \textbf{7.6}$$

So, the total amount that would be in the account after two years, at 4% annual interest, would be $\$1{,}000 + \$40.00 + \$41.60 = \$1{,}081.60$.

To determine any future value of money in an interest-bearing account, we multiply the principal amount by 1 plus the interest rate for each year the money remains in the account. From this, we can develop the future value formula:

$$\text{Future Value} = \text{Original Deposit} \times (1 + r) \times (1 + r) \quad \textbf{7.7}$$

In this formula, the number of times we multiply by $(1 + r)$ depends entirely on the number of years the money will remain in the bank account, earning interest, before it is withdrawn in a final lump sum distribution paid out from the account at the end of the chosen savings period. The 1 in the formula represents the principal amount, or the original $1,000 deposit, which will be included in the final total lump sum payment when the account is closed and all money is withdrawn at the end of the predetermined savings period.

We can write the above equation in a more condensed mathematical form using time value of money notation, as follows:

$$\begin{aligned} \text{FV} &= \text{Future Value} \\ \text{PV} &= \text{Present Value} \\ r &= \text{Interest Rate} \\ n &= \text{Number of Periods} \end{aligned} \quad \textbf{7.8}$$

Using these inputs, we have the following formula:

$$\text{FV} = \text{PV} \times (1 + r)^n \quad \textbf{7.9}$$

With this equation, we can calculate the value of the savings account after any number of years. For example, suppose we are considering 3, 10, and 50 years from the original deposit date at the annual 4% interest rate:

$$\begin{aligned} \text{3 years:} \quad & \text{FV} = \$1{,}000 \times (1.04)^3 = \$1{,}000 \times 1.12486 = \$1{,}124.86 \\ \text{10 years:} \quad & \text{FV} = \$1{,}000 \times (1.04)^{10} = \$1{,}000 \times 1.48024 = \$1{,}480.24 \\ \text{50 years:} \quad & \text{FV} = \$1{,}000 \times (1.04)^{50} = \$1{,}000 \times 7.106683 = \$7{,}106.68 \end{aligned} \quad \textbf{7.10}$$

How can this savings account have grown to be so large after 50 years? This question is answered by the impact of compounding interest. Every year, the interest earned in previous years will also earn interest along with the initial deposit. This will have the effect of accelerating the growth of the total dollar value of the account.

This is the important effect of the compounding of interest: money grows in larger and larger increments the longer you leave it in an interest-bearing account. In effect, the compounding of interest over time accelerates the growth of money.

In order to determine the FV of any amount of money, it will always be necessary to know the following pieces of information: (1) the principal, initial deposit, or **present value (PV)**; (2) the rate of interest, usually expressed on an annual basis as *r*; and (3) the number of time periods that the money will remain in the account (*n*). The interest rate is often referred to as the **growth rate**, or the annual percentage increase on savings or on an investment. When the rate is raised to the power of the number of periods, the formula $(1 + r)^n$ will yield a number that is commonly referred to as the future value interest factor (FVIF). As a result of this process, as *n* (time, or the number of periods) increases, the future value interest factor will increase. Also, as *r* (interest rate) increases, the FVIF will increases. For these reasons, the future value calculation is directly determined by both the interest rate being used and the total amount of time—specifically, the number of periods—being considered.

THINK IT THROUGH

### Calculating Future Values

Here's another example of calculating future values in multiple-period scenarios.

On a recent drive, you spotted your dream home, which is currently listed at $400,000. Unfortunately, you are not in a position to buy it right away and will have to wait at least another six years before you can afford it. If house values are appreciating at an annual rate of inflation of 4%, how much will a similar house cost after six years?

**Solution:**

In this case, PV is the current cost of the house, or $400,000; *n* is six years; *r* is the average annual inflation rate, or 4%; and we have to solve for FV.

$$\begin{aligned} \text{FV} &= \$400{,}000 \times (1.04)^6 \\ &= \$400{,}000 \times (1.265319) = \$506{,}127.61 \end{aligned} \tag{7.11}$$

Therefore, under these circumstances, the house will cost $506,127.60 after six years.

## How Time Impacts Compounding

We have just seen that time will lead to the growth of our money. As long as the prevailing growth or interest rate of any account we have our money in is positive, the passage of time will have the effect of growing the value of our money. The longer the period of time, the greater the growth and the larger the future value of the money will be. This can be reinforced very clearly with the following example.

Melvin is saving money in an account at a local bank that earns 5% per year. He begins with a deposit in his account of $100 and decides to save his money for exactly one year. He will not be making any further deposits into the account during the year. Melvin will earn $5\% \times \$100,$ or $5, in interest income. Adding this to the original deposit balance of $100 will give him a total of $\$100 + \$5,$ or $105, in the account at the end of one year.

Melvin likes this idea and believes he may be able to keep his money in the account for a longer period of time.

How much money will he have in his account, without any further deposits, at the end of years two, three, four, and five?

Using the future value formula, the calculation is as follows:

$$\begin{aligned} \text{FV} &= \text{PV} \times (1+r)^n \\ \text{Year 2: FV} &= \$100 \times (1+0.05)^2 = \$110.25 \\ \text{Year 3: FV} &= \$100 \times (1+0.05)^3 = \$115.76 \\ \text{Year 4: FV} &= \$100 \times (1+0.05)^4 = \$121.55 \\ \text{Year 5: FV} &= \$100 \times (1+0.05)^5 = \$127.63 \end{aligned} \quad \textbf{7.12}$$

### How the Interest Rate Impacts Compounding

Melvin likes the idea of earning more money over time, but he also believes that what he would earn in interest may not be enough for some of the things he plans to buy in the future. His friend suggests finding an account or some form of investment with a greater interest rate than the 5% he can get at his local bank.

Melvin thinks he can leave his money in an account or investment for a total of five years. He found investments that will provide annual returns of 6%, 7%, 10%, and 12%. Using the $\text{FV} = \text{PV} \times (1+r)^n$ formula, we can complete the following calculations for him:

$$\begin{aligned} 5\%\text{: FV} &= \$100 \times (1+0.05)^5 = \$127.63 \\ 6\%\text{: FV} &= \$100 \times (1+0.06)^5 = \$133.82 \\ 7\%\text{: FV} &= \$100 \times (1+0.07)^5 = \$140.26 \\ 10\%\text{: FV} &= \$100 \times (1+0.10)^5 = \$161.05 \\ 12\%\text{: FV} &= \$100 \times (1+0.12)^5 = \$176.23 \end{aligned} \quad \textbf{7.13}$$

Again, Melvin likes this information, and he states that he will try to find the highest interest rate available. This makes sense, but it's important to remember that investments are usually not guaranteed to earn you specific interest rates, or rates of return. Most investments, other than **Treasury investments** such as Treasury bonds, carry some form of **financial risk**, either small or large, and the greater the rate of return, the more likely it is that the risk associated with the investment will also be greater. This risk does not have any effect on the future calculations we have just completed, but it an important factor to bear in mind and consider well before moving ahead and putting your money in any investment or **financial instrument**.

## 7.3 Methods for Solving Time Value of Money Problems

### Learning Outcomes

By the end of this section, you will be able to:

- Explain how future dollar amounts are calculated.
- Explain how present dollar amounts are calculated.
- Describe how discount rates are calculated.
- Describe how growth rates are calculated.
- Illustrate how periods of time for specified growth are calculated.
- Use a financial calculator and Excel to solve TVM problems.

We can determine future value by using any of four methods: (1) mathematical equations, (2) calculators with financial functions, (3) spreadsheets, and (4) FVIF tables. With the advent and wide acceptance and use of financial calculators and spreadsheet software, FVIF (and other such time value of money tables and factors) have become obsolete, and we will not discuss them in this text. Nevertheless, they are often still published in other finance textbooks and are also available on the internet to use if you so choose.

## Using Timelines to Organize TVM Information

A useful tool for conceptualizing present value and future value problems is a timeline. A timeline is a visual, linear representation of periods and cash flows over a set amount of time. Each timeline shows today at the left and a desired ending, or future point (maturity date), at the right.

Now, let us take an example of a future value problem that has a time frame of five years. Before we begin to solve for any answers, it would be a good approach to lay out a timeline like that shown in Table 7.1:

| Year | 0 (Today) | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| | | | | | | |

**Table 7.1**

The timeline provides a visual reference for us and puts the problem into perspective.

Now, let's say that we are interested in knowing what today's balance of $100 in our saving account, earning 5% annually, will be worth at the end of each of the next five years. Using the future value formula

$$\text{FV} = \text{PV} \times (1 + r)^n \tag{7.14}$$

that we covered earlier, we would arrive at the following values: $105 at the end of year one, $110.25 at the end of year two, $115.76 at the end of year three, $121.55 at the end of year four, and $127.63 at the end of year five.

With the numerical information, the timeline (at a 5% interest or growth rate) would look like Table 7.2:

| Year | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| | $100.00 | $105.00 | $110.25 | $115.76 | $121.55 | $127.63 |

**Table 7.2**

Using timelines to lay out TVM problems becomes more and more valuable as problems become more complex. You should get into the habit of using a timeline to set up these problems prior to using the equation, a calculator, or a spreadsheet to help minimize input errors. Now we will move on to the different methods available that will help you solve specific TVM problems. These are the financial calculator and the Excel spreadsheet.

## Using a Financial Calculator to Solve TVM Problems

An extremely popular method of solving TVM problems is through the use of a financial calculator. Financial calculators such as the Texas Instruments BAII Plus™ Professional (https://openstax.org/r/baii-plus-professional) will typically have five keys that represent the critical variables used in most common TVM problems: `N`, `I/Y`, `PV`, `FV`, and `PMT`. These represent the following:

$$\begin{gathered}\text{N: Number of Periods} \\ \text{I/Y: Interest Rate (Interest per Year)} \\ \text{PV: Present Value of a Lump Sum} \\ \text{V: Future Value of a Lump Sum} \\ \text{PMT: Payment}\end{gathered} \tag{7.15}$$

These are the only keys on a financial calculator that are necessary to solve TVM problems involving a **single payment or lump sum**.

## Example 1: Future Value of a Single Payment or Lump Sum

Let's start with a simple example that will provide you with most of the skills needed to perform TVM functions involving a single lump sum payment with a financial calculator.

Suppose that you have $1,000 and that you deposit this in a savings account earning 3% annually for a period of four years. You will naturally be interested in knowing how much money you will have in your account at the end of this four-year time period (assuming you make no other deposits and withdraw no cash).

To answer this question, you will need to work with factors of $1,000, the present value (PV); four periods or years, represented by N; and the 3% interest rate, or I/Y. Make sure that the calculator register information is cleared, or you may end up with numbers from previous uses that will interfere with the solution. The register-clearing process will depend on what type of calculator you are using, but for the TI BA II Plus™ Professional calculator, clearing can be accomplished by pressing the keys 2ND and FV [CLR TVM].

Once you have cleared any old data, you can enter the values in the appropriate key areas: 4 for N, 3 for I/Y, and 1000 for PV. Now you have entered enough information to calculate the future value. Continue by pressing the CPT (compute) key, followed by the FV key. The answer you end up with should be displayed as 1,125.51 (see Table 7.3).

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 1 | Clear calculator register | CE/C | | 0.00 |
| 2 | Enter present value (as a negative integer) | 1000 +\|– PV | PV = | -1,000.00 |
| 3 | Enter interest rate | 3 I/Y | I/Y = | 3.00 |
| 4 | Enter time periods | 4 N | N = | 4.00 |
| 5 | Indicate no payments or deposits | 0 PMT | PMT = | 0.00 |
| 6 | Compute future value | CPT FV | FV = | 1,125.51 |

**Table 7.3 Calculator Steps for Finding the Future Value of a Single Payment or Lump Sum**[1]

## Important Notes for Using a Calculator and the Cash Flow Sign Convention

Please note that the PV was entered as negative $1,000 (or -$1000). This is because most financial calculators (and spreadsheets) follow something called the cash flow sign convention, which is a way for calculators and spreadsheets to keep the relative direction of the cash flow straight. Positive numbers are used to represent cash inflows, and negative numbers should always be used for cash outflows.

In this example, the $1,000 is an investment that requires a cash outflow. For this reason, -1000 is entered as the present value, as you will be essentially handing this $1,000 to a bank or to someone else to initiate the transaction. Conversely, the future value represents a cash inflow in four years' time. This is why the calculator generates a positive 1,125.51 as the end result of this calculation.

Had you entered the present value of $1,000 as a positive number, there would have been no real concern, but the ending future value answer would have been returned expressed as a negative number. This would be correct had you borrowed $1,000 today (cash inflow) and agreed to repay $1,125.51 (cash outflow) four years from now. Also, it is important that you do not change the sign of any input value by using the – (minus) key). For example, on the TI BA II Plus™ Professional, you must use the +|– key instead of the minus key. If you enter 1000 and then hit the +|– key, you will get a negative 1,000 amount showing in the calculator display.

1 The specific financial calculator in these examples is the Texas Instruments BA II Plus™ Professional model, but you can use other financial calculators for these types of calculations.

An important feature of most financial calculators is that it is possible to change any of the variables in a problem without needing to reenter all of the other data. For example, suppose that we wanted to find out the future value in our bank account if we left the money from our previous example invested for 20 years instead of 4. Before clearing any of the data, simply enter 20 for N and then press the CPT key and then the FV key. After this is done, all other inputs will remain the same, and you will arrive at an answer of $1,806.11.

THINK IT THROUGH

### How to Determine Future Value When Other Variables Are Known

Here's an example of using a financial calculator to solve a common time value of money problem. You have $2,000 invested in a money market account that is expected to earn 4% annually. What will be the total value in the account after five years?

**Solution:**

Follow the recommended financial calculator steps in Table 7.4.

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 1 | Clear calculator register | CE/C | | 0.00 |
| 2 | Enter present value (as a negative integer) | 2000 +\|– PV | PV = | -2,000.00 |
| 3 | Enter interest rate | 4 I/Y | I/Y = | 4.00 |
| 4 | Enter time periods | 5 N | N = | 5.00 |
| 5 | Indicate no payments or deposits | 0 PMT | PMT = | 0.00 |
| 6 | Compute future value | CPT FV | FV = | 2,433.31 |

**Table 7.4 Calculator Steps for Determining Future Value**

The result of this future value calculation of the invested money is $2,433.31.

## Example 2: Present Value of Lump Sums

Solving for the present value (discounted value) of a lump sum is the exact opposite of solving for a future value. Once again, if we enter a negative value for the FV, then the calculated PV will be a positive amount.

Taking the reverse of what we did in our example of future value above, we can enter -1,125.51 for FV, 3 for I/Y, and 4 for N. Hit the CPT and PV keys in succession, and you should arrive at a displayed answer of 1,000.

An important constant within the time value of money framework is that the present value will always be less than the future value unless the interest rate is negative. It is important to keep this in mind because it can help you spot incorrect answers that may arise from errors with your input.

THINK IT THROUGH

### How to Determine Present Value When Other Variables Are Known

Here is another example of using a financial calculator to solve a common time value of money problem. You have just won a second-prize lottery jackpot that will pay a single total lump sum of $50,000 five years from now. How much value would this have in today's dollars, assuming a 5% interest rate?

**Solution:**

Follow the recommended financial calculator steps in Table 7.5.

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 1 | Clear calculator register | CE/C | | 0.00 |
| 2 | Enter future value (as a negative integer) | 50000 +\|− FV | FV = | -50,000.00 |
| 3 | Enter interest rate | 5 I/Y | I/Y = | 5.00 |
| 4 | Enter time periods | 5 N | N = | 5.00 |
| 5 | Indicate no payments or deposits | 0 PMT | PMT = | 0.00 |
| 6 | Compute present value | CPT PV | PV = | 39,176.31 |

**Table 7.5 Calculator Steps for Determining Present Value**

The present value of the lottery jackpot is $39,176.31.

## Example 3: Calculating the Number of Periods

There will be times when you will know both the value of the money you have now and how much money you will need to have at some unknown point in the future. If you also know the interest rate your money will be earning for the foreseeable future, then you can solve for N, or the exact amount of time periods that it will take for the present value of your money to grow into the future value that you will require for your eventual use.

Now, suppose that you have $100 today and you would like to know how long it will take for you to be able to purchase a product that costs $133.82.

After making sure your calculator is clear, you will enter 5 for I/Y, -100 for PV, and 133.82 for FV. Now press CPT N, and you will see that it will take 5.97 years for your money to grow to the desired amount of $133.82.

Again, an important thing to note when using a financial calculator to solve TVM problems is that you must enter your numbers according to the cash flow sign convention discussed above. If you do not make either the PV or the FV a negative number (with the other being a positive number), then you will end up getting an error message on the screen instead of the answer to the problem. The reason for this is that if both numbers you enter for the PV and FV are positive, the calculator will operate under the assumption that you are receiving a financial benefit without making any cash outlay as an initial investment. If you get such an error message in your calculations, you can simply press the CE/C key. This will clear the error, and you can reenter your data correctly by changing the sign of either PV or FV (but not both of these, of course).

### THINK IT THROUGH

#### Determining Periods of Time

Here is an additional example of using a financial calculator to solve a common time value of money problem. You want to be able to contribute $25,000 to your child's first year of college tuition and related expenses. You currently have $15,000 in a tuition savings account that is earning 6% interest every year. How long will it take for this account grow into the targeted amount of $25,000, assuming no additional deposits or withdrawals will be made?

**Solution:**

Table 7.6 shows the steps you will take.

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 1 | Clear calculator register | CE/C | | 0.0000 |
| 2 | Enter present value (as a negative integer) | 15000 +\|– PV | PV = | -15,000.0000 |
| 3 | Enter interest rate | 6 I/Y | I/Y = | 6.0000 |
| 4 | Enter future value | 25000 FV | FV = | 25,000.0000 |
| 5 | Indicate no payments or deposits | 0 PMT | PMT = | 0.0000 |
| 6 | Compute time periods | CPT N | N = | 8.7667 |

**Table 7.6 Calculator Steps for Determining Period of Time**

The result of this calculation is a time period of 8.7667 years for the account to reach the targeted amount.

## Example 4: Solving for the Interest Rate

Solving for an interest rate is a common TVM problem that can be easily addressed with a financial calculator. Let's return to our earlier example, but in this case, we know that we have $1,000 at the present time and that we will need to have a total of $1,125.51 four years from now. Let's also say that the only way we can add to the current value of our savings is through interest income. We will not be able to make any further deposits in addition to our initial $1,000 account balance.

What interest rate should we be sure to get on our savings account in order to have a total savings account value of $1,125.51 four years from now?

Once again, clear the calculator, and then enter 4 for N, -1,000 for PV, and 1,125.51 for FV. Then, press the CPT and I/Y keys and you will find that you need to earn an average 3% interest per year in order to grow your savings balance to the desired amount of $1,125.51. Again, if you end up with an error message, you probably failed to follow the sign convention relating to cash inflow and outflow that we discussed earlier. To correct this, you will need to clear the calculator and reenter the information correctly.

After you believe you are done and have arrived at a final answer, always make sure you give it a quick review. You can ask yourself questions such as "Does this make any sense?" "How does this compare to other answers I have arrived at?" or "Is this logical based on everything I know about the scenario?" Knowing how to go about such a review will require you to understand the concepts you are attempting to apply and what you are trying to make the calculator do. Further, it is critical to understand the relationships among the different inputs and variables of the problem. If you do not fully understand these relationships, you may end up with an incorrect answer. In the end, it is important to realize that any calculator is simply a tool. It will only do what you direct it to do and has no idea what your objective is or what it is that you really wish to accomplish.

### THINK IT THROUGH

#### Determining Interest or Growth Rate

Here is another example of using a financial calculator to solve a common time value of money problem. Let's use a similar example to the one we used when calculating periods of time to determine an interest or growth rate. You still want to help your child with their first year of college tuition and related expenses. You

also still have a starting amount of $15,000, but you have not yet decided on a savings plan to use.

Instead, the information you now have is that your child is just under 10 years old and will begin college at age 18. For simplicity's sake, let's say that you have eight and a half years before you will need to meet your total savings target of $25,000. What rate of interest will you need to grow your saved money from $15,000 to $25,000 in this time period, again with no other deposits or withdrawals?

**Solution:**

Follow the steps shown in Table 7.7.

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 1 | Clear calculator register | CE/C | | 0.0000 |
| 2 | Enter present value (as a negative integer) | 15000 +\|– PV | PV = | -15,000.0000 |
| 3 | Enter time periods | 8.5 N | N = | 8.5000 |
| 4 | Enter future value | 25000 FV | FV = | 25,000.0000 |
| 5 | Indicate no payments or deposits | 0 PMT | PMT = | 0.0000 |
| 6 | Compute interest rate | CPT I/Y | I/Y = | 6.1940 |

**Table 7.7 Calculator Steps for Determining Interest Rate**

The result of this calculation is a necessary interest rate of 6.194%.

## Using Excel to Solve TVM Problems

Excel spreadsheets can be excellent tools to use when solving time value of money problems. There are dozens of financial functions available in Excel, but a student who can use a few of these functions can solve almost any TVM problem. Special functions that relate to TVM calculations are as follows:

Future Value (FV) **7.16**

Present Value (PV) **7.17**

Number of Periods (NPER) **7.18**

Interest Rate (RATE) **7.19**

Excel also includes a function called Payment (PMT) that is used in calculations involving multiple payments or deposits (annuities). These will be covered in Time Value of Money II: Equal Multiple Payments.

### Future Value (FV)

The Future Value function in Excel is also referred to as FV and can be used to calculate the value of a single lump sum amount carried to any point in the future. The FV function syntax is similar to that of the other four basic time-value functions and has the following inputs (referred to as arguments), similar to the functions listed above:

Rate: Interest Rate **7.20**

Nper: Number of Periods **7.21**

Pmt: Payment **7.22**

PV: Present Value **7.23**

Lump sum problems do not involve payments, so the value of Pmt in such calculations is 0. Another argument, Type, refers to the timing of a payment and carries a default value of the end of the period, which is the most common timing (as opposed to the beginning of a period). This may be ignored in our current example, which means the default value of the end of the period will be used.

The spreadsheet in Figure 7.3 shows two examples of using the FV function in Excel to calculate the future value of $100 in five years at 5% interest.

In cell E1, the FV function references the values in cells B1 through B4 for each of the arguments. When a user begins to type a function into a spreadsheet, Excel provides helpful information in the form of on-screen tips showing the argument inputs that are required to complete the function. In our spreadsheet example, as the FV formula is being typed into cell E2, a banner showing the arguments necessary to complete the function appears directly below, hovering over cell E3.

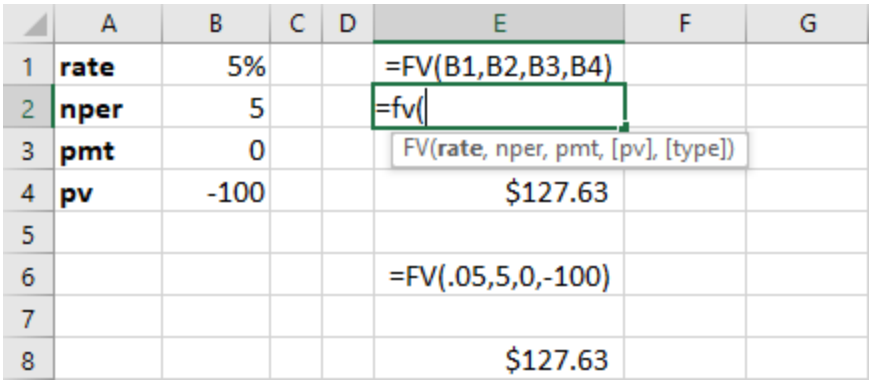


**Figure 7.3 Using the FV Function in Excel**

Cells E1 and E2 show how the FV function appears in the spreadsheet as it is typed in with the required arguments. Cell E4 shows the calculated answer for cell E1 after hitting the enter key. Once the enter key is pressed, the hint banner hovering over cell E3 will disappear. The second example of the FV function in our example spreadsheet is in cell E6. Here, the actual numerical values are used in the FV function equation rather than cell references. The method in cell E8 is referred to as *hard coding*. In general, it is preferable to use the cell reference method, as this allows for copying formulas and provides the user with increased flexibility in accounting for changes to input data. This ability to accept cell references in formulas is one of the greatest strengths of Excel as a spreadsheet tool.

*Download the spreadsheet file (https://openstax.org/r/docs.google_uc_export) containing key Chapter 7 Excel exhibits.*

**Determining Future Value When Other Variables Are Known**. You have $2,000 invested in a money market account that is expected to earn 4% annually. What will be the total value in the account in five years?

$$\text{Present Value (PV)} = (\$2{,}000.00) \tag{7.24}$$

Note: Be sure to follow the sign conventions. In this case, the PV should be entered as a negative value.

$$\text{Interest Rate (Rate or I/Y)} = 4\% \tag{7.25}$$

Note: In Excel, interest and growth rates must be entered as percentages, not as whole integers. So, 4 percent must be entered as 4% or 0.04—not 4, as you would enter in a financial calculator.

$$\text{Number of Periods (Nper or N)} = 5.00 \tag{7.26}$$

Note: It is always assumed that if not specifically stated, the compounding period of any given interest rate is annual, or based on years.

$$\text{Future Value (FV)} = \$2{,}433.31 \tag{7.27}$$

Note: The Excel command used to calculate future value is as follows:

```
=FV(rate, nper, pmt, [pv], [type])
```

You may simply type the values for the arguments in the above formula. Another option is to use the Excel insert function option. If you decide on this second method, below are several screenshots of dialog boxes you will encounter and will be required to complete.

1. First, go to Formulas in the upper menu bar, and select the Insert Function option. When you do so, a dialog box will appear that looks like what you see in Figure 7.4.

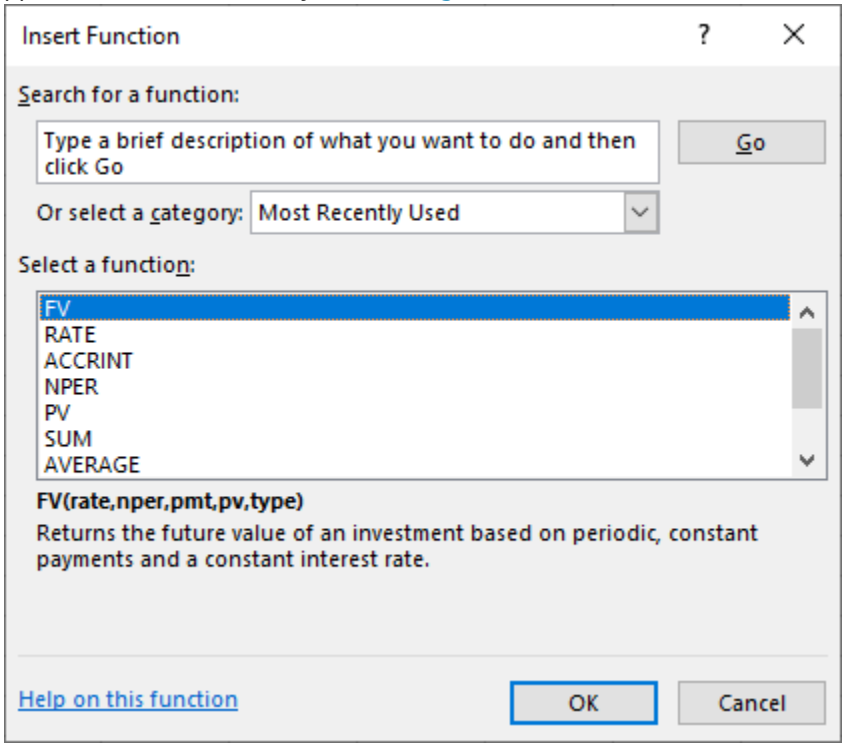


**Figure 7.4 Dialog Box to Insert FV Function**

   This dialog box allows you to either search for a function or select a function that has been used recently. In this example, you can search for FV by typing this in the search box and selecting Go, or you can simply choose FV from the list of most recently used functions (as shown here with the highlighted FV option).

2. Once you select FV and click the OK button, a new dialog box will appear for you to enter the necessary details. See Figure 7.5.

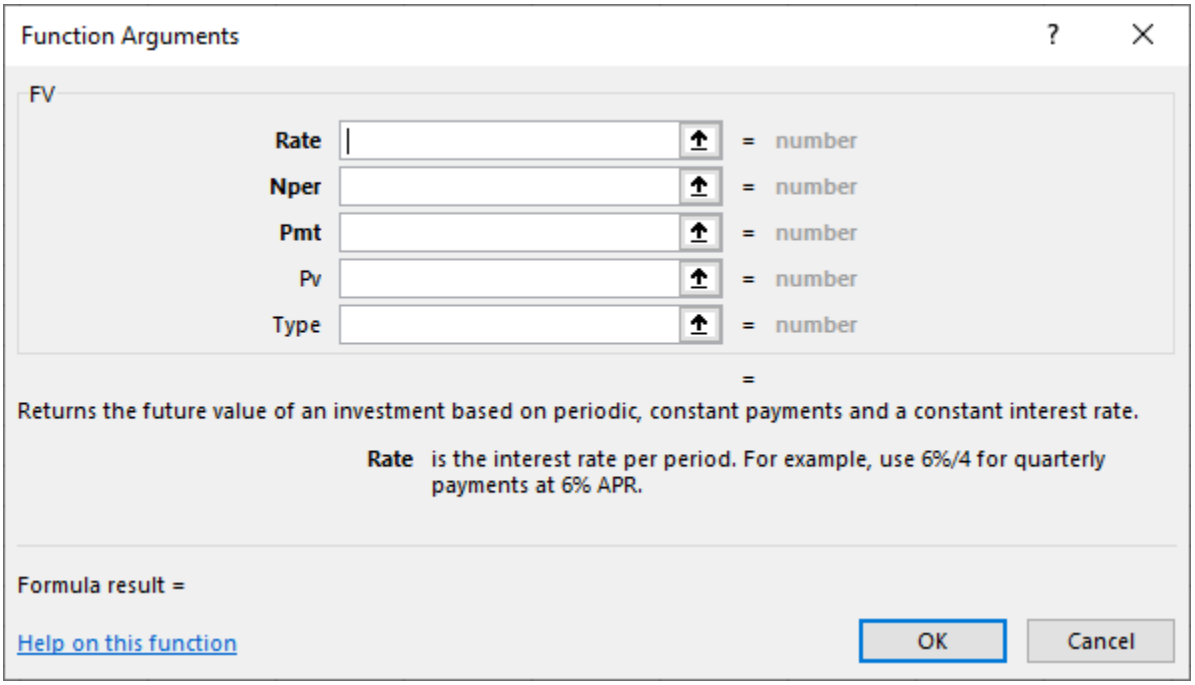


**Figure 7.5 New Dialog Box for FV Function Arguments**

Figure 7.6 shows the completed data input for the variables, referred to here as "function arguments." Note that cell addresses are used in this example. This allows the spreadsheet to still be useful if you decide to change any of the variables. You may also type values directly into the Function Arguments dialog box, but if you do this and you have to change any of your inputs later, you will have to reenter the new information. Using cell addresses is always a preferable method of entering the function argument data.

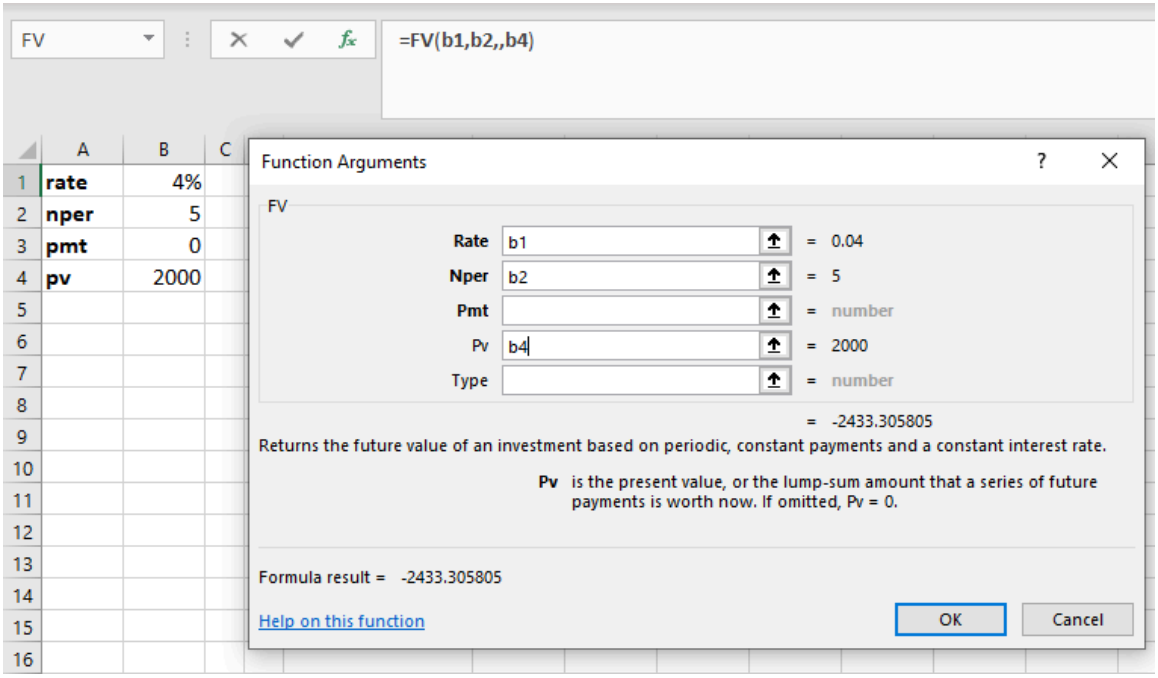


**Figure 7.6 Completed Data Entry Menu for FV Function Arguments**

Additional notes:

1. The Pmt argument or variable can be ignored in this instance, or you can enter a placeholder value of

zero. This example shows a blank or ignored entry, but either option may be used in problems such as this where the information is not relevant.

2. The Type argument does not apply to this problem. Type refers to the timing of cash flows and is usually used in multiple payment or annuity problems to indicate whether payments or deposits are made at the beginning of periods or at the end. In single lump sum problems, this is not relevant information, and the Type argument box is left empty.
3. When you use cell addresses as function argument inputs, the numerical values within the cells are displayed off to the right. This helps you ensure that you are identifying the correct cells in your function. The final answer generated by the function is also displayed for your preliminary review.

Once you are satisfied with the result, hit the OK button, and the dialog box will disappear, with only the final numerical result appearing in the cell where you have set up the function.

The FV of this present value has been calculated as approximately $2,433.31.

## Present Value (PV)

We have covered the idea that present value is the opposite of future value. As an example, in the spreadsheet shown in Figure 7.3, we calculated that the future value of $100 five years from now at a 5% interest rate would be $127.63. By reversing this process, we can safely state that $127.63 received five years from now with a 5% interest (or discount) rate would have a value of just $100 today. Thus, $100 is its present value. In Excel, the PV function is used to determine present value (see Figure 7.7).

| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| 1 | **rate** | 5% | | | =PV(B1,B2,B3,B4) | | |
| 2 | **nper** | 5 | | | =pv( | | |
| 3 | **pmt** | 0 | | | PV(**rate**, nper, pmt, [fv], [type]) | | |
| 4 | **fv** | -127.6 | | | $100.00 | | |
| 5 | | | | | | | |
| 6 | | | | | =PV(.05,5,0,-100) | | |
| 7 | | | | | | | |
| 8 | | | | | $100.00 | | |

**Figure 7.7 Using the PV Function in Excel**

The formula in cell E1 uses cell references in a similar fashion to our FV example spreadsheet above. Also similar to our earlier example is the hard-coded formula for this calculation, which is shown in cell E6. In both cases, the answers we arrive at using the PV function are identical, but once again, using cell references is preferred over hard coding if possible.

### THINK IT THROUGH

#### Determining Present Value When Other Variables Are Known

You have just won a second-prize lottery jackpot that will pay a single total lump sum of $50,000 five years from now. You are interested in knowing how much value this would have in today's dollars, assuming a 5% interest rate.

$$\begin{aligned} \text{Future Value (FV)} &= (\$50{,}000.00) \\ \text{Interest Rate (Rate or I/Y)} &= 5\% \\ \text{Number of Periods (Nper or N)} &= 5.00 \\ \text{Present Value (PV)} &= \$39{,}176.31 \end{aligned} \tag{7.28}$$

Notes:

1. If you wish for the present value amount to be positive, the future value you enter here should be a negative value.
2. In Excel, interest and growth rates must be entered as percentages, not as whole integers. So, 5 percent must be entered as 5% or 0.05—not 5, as you would enter in a financial calculator.
3. It is always assumed that if not specifically stated, the compounding period of any given interest rate is annual, or based on years.
4. The Excel command used to calculate present value is as shown here:

```
=PV(rate, nper, pmt, [fv], [type])
```

**Solution:**

As with the FV formula covered in the first tab of this workbook, you may simply type the values for the arguments in the above formula. Another option is to again use the Insert Function option in Excel. Figure 7.8, Figure 7.9, and Figure 7.10 provide several screenshots that demonstrate the steps you'll need to follow if you decide to enter the PV function from the Insert Function menu.

1. First, go to Formulas in the upper menu bar, and select Insert Function. When you do so, the Insert Function dialog box will appear (see Figure 7.8).

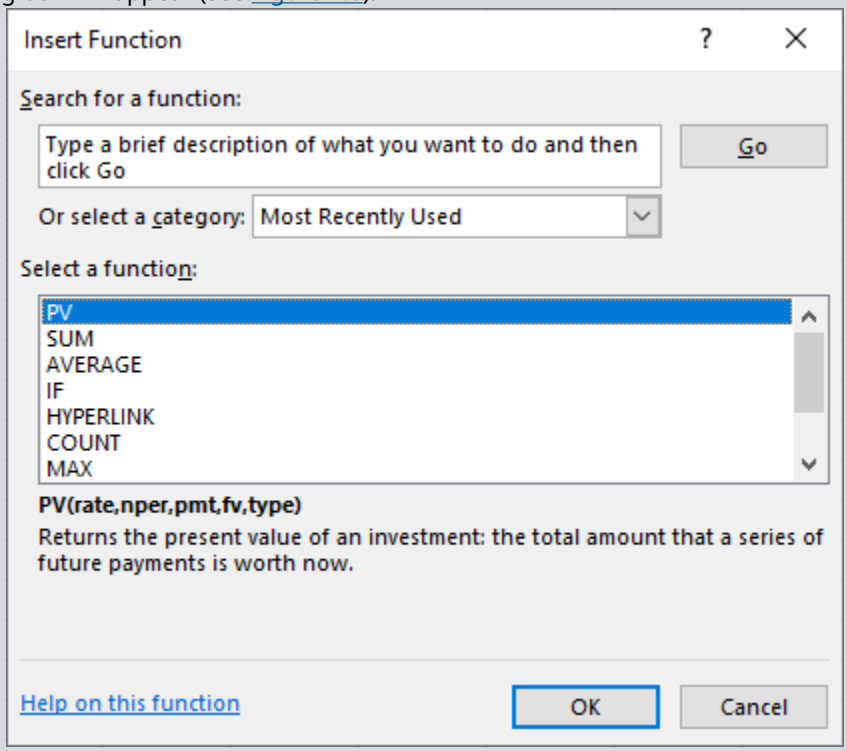


**Figure 7.8 Dialog Box to Insert PV Function**

   As discussed in the FV function example above, this dialog box allows you to either search for a function or select a function that has been used recently. In this example, you can search for PV by typing this into the search box and selecting Go, or you can simply choose PV from the list of the most recently used functions.

2. Once you have highlighted PV, click the OK button, and a new dialog box will appear for you to enter the necessary details. Similar to our FV function example, it will look like Figure 7.9.

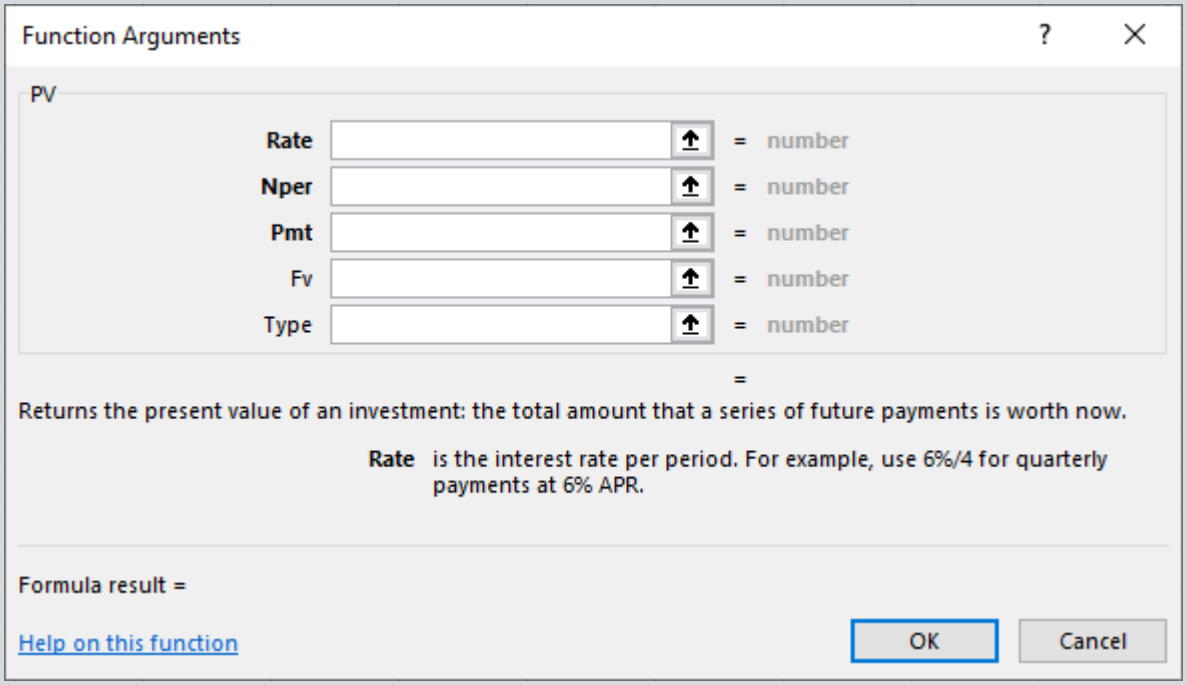


**Figure 7.9 New Dialog Box for PV Function Arguments**

Figure 7.10 shows the completed data input for the function arguments. Note that once again, cell addresses are used in this example. This allows the spreadsheet to still be useful if you decide to change any of the variables. As in the FV function example, you may also type values directly in the Function Arguments dialog box, but if you do this and you have to change any of your input later, you will have to reenter the new information. Remember that using cell addresses is always a preferable method of entering the function argument data.

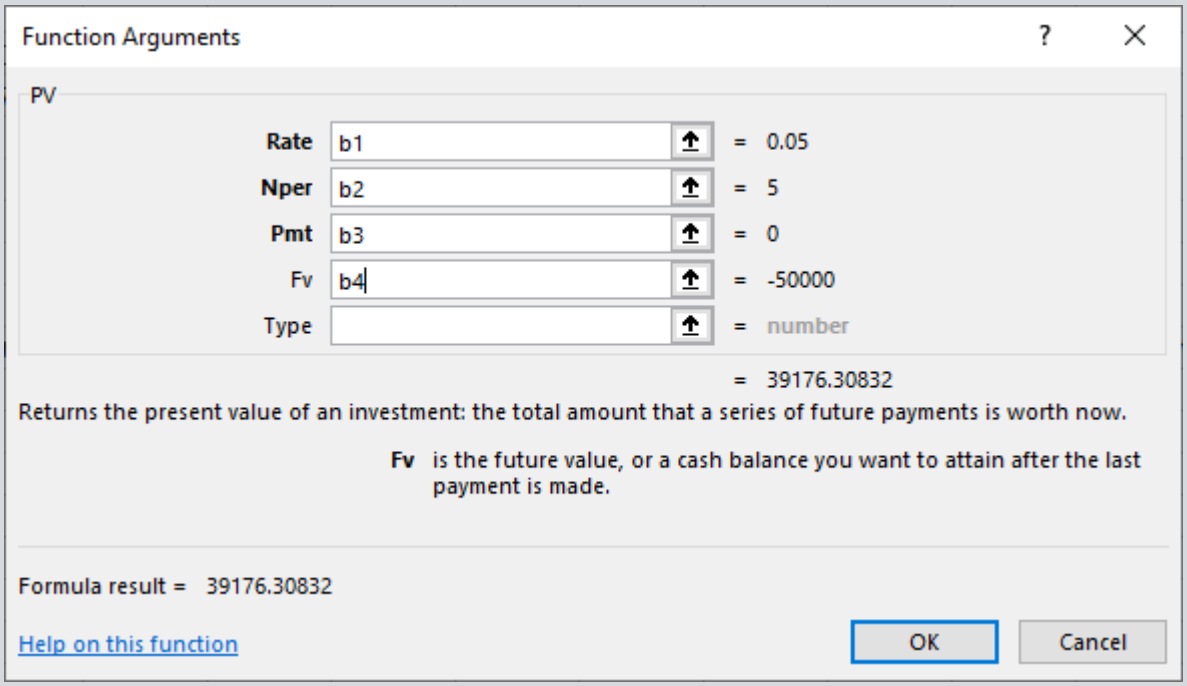


**Figure 7.10 Completed Dialog Box for PV Function Arguments**

Again, similar to our FV function example, the Function Arguments dialog box shows values off to the

right of the data entry area, including our final answer. The Pmt and Type boxes are again not relevant to this single lump sum example, for reasons we covered in the FV example.

Review your answer. Once you are satisfied with the result, click the OK button, and the dialog box will disappear, with only the final numerical result appearing in the cell where you have set up the function. The PV of this future value has been calculated as approximately $39,176.31.

## Periods of Time

The following discussion will show you how to use Excel to determine the amount of time a given present value will need to grow into a specified future value when the interest or growth rate is known.

You want to be able to contribute $25,000 to your child's first year of college tuition and related expenses. You currently have $15,000 in a tuition savings account that is earning 6% interest every year. How long will it take for this account grow into the targeted amount of $25,000, assuming no additional deposits or withdrawals are made?

$$\begin{aligned} \text{Future Value (FV)} &= \$25{,}000.00 \\ \text{Interest Rate (Rate or I/Y)} &= 6\% \\ \text{Present Value (PV)} &= (\$15{,}000.00) \\ \text{Number of Periods (NPER)} &= 8.7667 \end{aligned} \tag{7.29}$$

Notes:

1. As with our other examples, interest and growth rates must be entered as percentages, not as whole integers. So, 6 percent must be entered as 6% or 0.06—not 6, as you would enter in a financial calculator.
2. The present value needs to be entered as a negative value in accordance with the sign convention covered earlier.
3. The Excel command used to calculate the amount of time, or number of periods, is this:

```
=NPER (rate, pmt, pv, [fv], [type])
```

As with our FV and PV examples, you may simply type the values of the arguments in the above formula, or we can again use the Insert Function option in Excel. If you do so, you will need to work with the various dialog boxes after you select Insert Function.

1. First, go to Formulas in the upper menu bar, and select the Insert Function option. When you do so, the Insert Function dialog box will appear (see Figure 7.11).

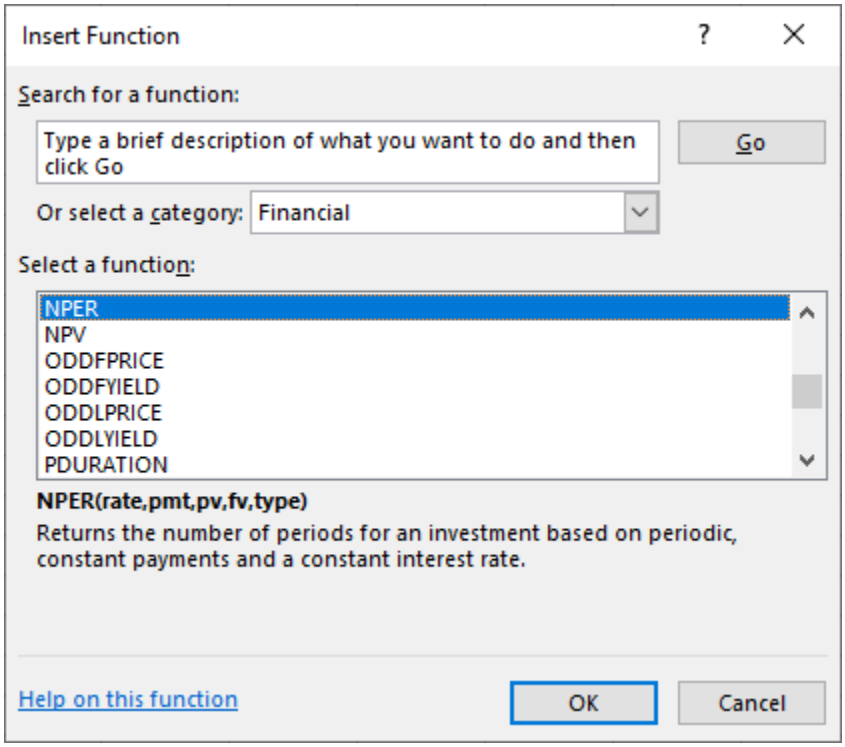


**Figure 7.11 Dialog Box to Insert NPER Function**

As discussed in our previous examples on FV and PV, this menu allows you to either search for a function or select a function that has been used recently. In this example, you can search for NPER by typing this into the search box and selecting Go, or you can simply choose NPER from the list of most recently used functions.

2. Once you have highlighted NPER, click the OK button, and a new dialog box will appear for you to enter the necessary details. As in our previous examples, it will look like Figure 7.12.

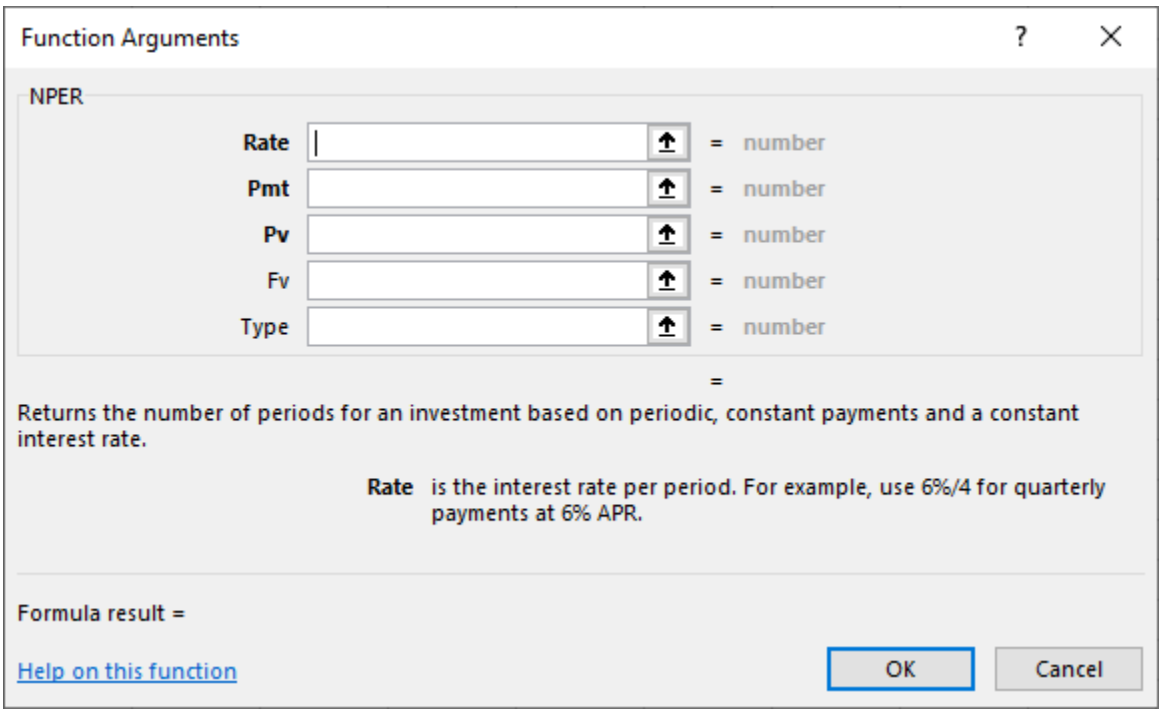


**Figure 7.12 New Dialog Box for NPER Function Arguments**

Figure 7.13 shows the completed Function Arguments dialog box. Note that once again, we are using cell addresses in this example.

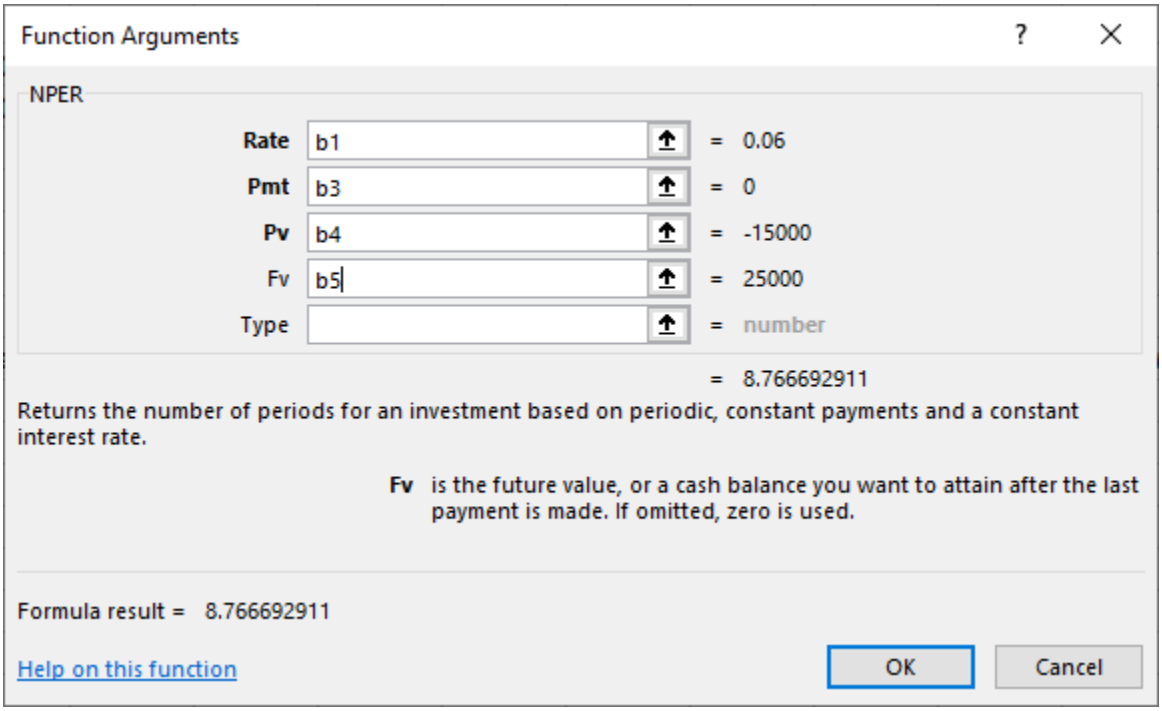


**Figure 7.13 Completed Dialog Box for NPER Function Arguments**

As in the previous function examples, values are shown off to the right of the data input area, and our final answer of approximately 8.77 is displayed at the bottom. Also, once again, the Pmt and Type boxes are not relevant to this single lump sum example.

Review your answer, and once you are satisfied with the result, click the OK button. The dialog box will disappear, with only the final numerical result appearing in the cell where you have set up the function.

The amount of time required for the desired growth to occur is calculated as approximately 8.77 years.

## Interest or Growth Rate

You can also use Excel to determine the required growth rate when the present value, future value, and total number of required periods are known.

Let's discuss a similar example to the one we used to calculate periods of time. You still want to help your child with their first year of college tuition and related expenses, and you still have a starting amount of $15,000, but you have not yet decided which savings plan to use.

Instead, the information you now have is that your child is just under 10 years old and will begin college at age 18. For simplicity's sake, let's say that you have eight and a half years until you will need to meet your total savings target of $25,000. What rate of interest will you need to grow your saved money from $15,000 to $25,000 in this time, again with no other deposits or withdrawals?

$$\begin{aligned} \text{Future Value (FV)} &= \$25{,}000.00 \\ \text{Number of Periods (Nper or N)} &= 8.50 \\ \text{Present/Value (PV)} &= (\$15{,}000.00) \end{aligned} \tag{7.30}$$

Note: The present value needs to be entered as a negative value.

`Interest Rate (RATE)`

Note: The Excel command used to calculate interest or growth rate is as follows:

```
=RATE(nper, pmt, pv, [fv], [type], [guess])
```

As with our other TVM function examples, you may simply type the values for the arguments into the above formula. We also again have the same alternative to use the Insert Function option in Excel. If you choose this option, you will again see the Insert Function dialog box after you click the Insert Function button.

1. First, go to Formulas in the upper menu bar, and select the Insert Function option. When you do so, the Insert Function dialog box will appear (see Figure 7.14).

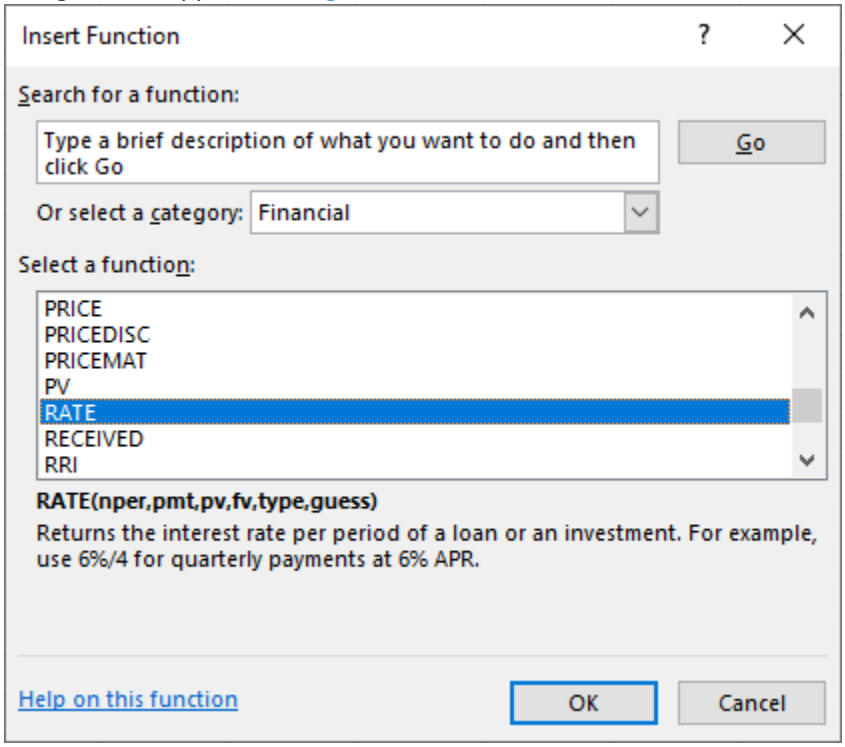


**Figure 7.14 Dialog Box to Insert RATE Function**

2. This time, find and highlight RATE, and click the OK button once you have done so. The Function Arguments dialog box will look like Figure 7.15.

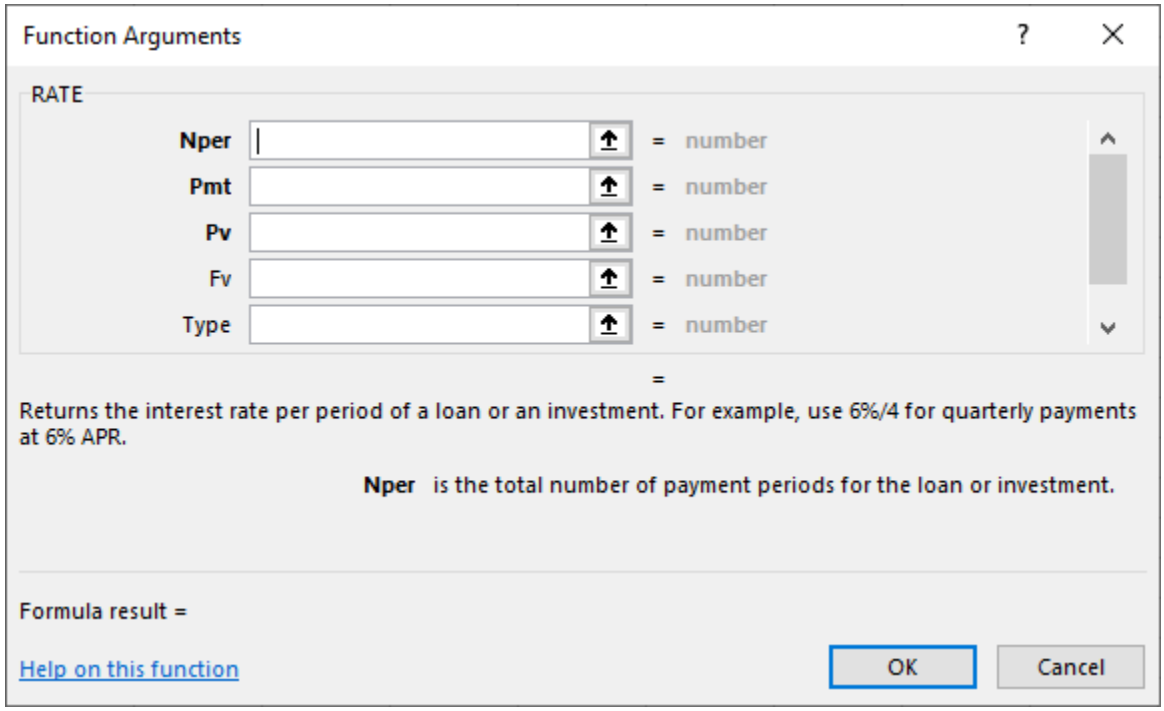


**Figure 7.15 New Dialog Box for RATE Function Arguments**

Once we complete the input, again using cell addresses for the required argument values, we will see what is shown in Figure 7.16.

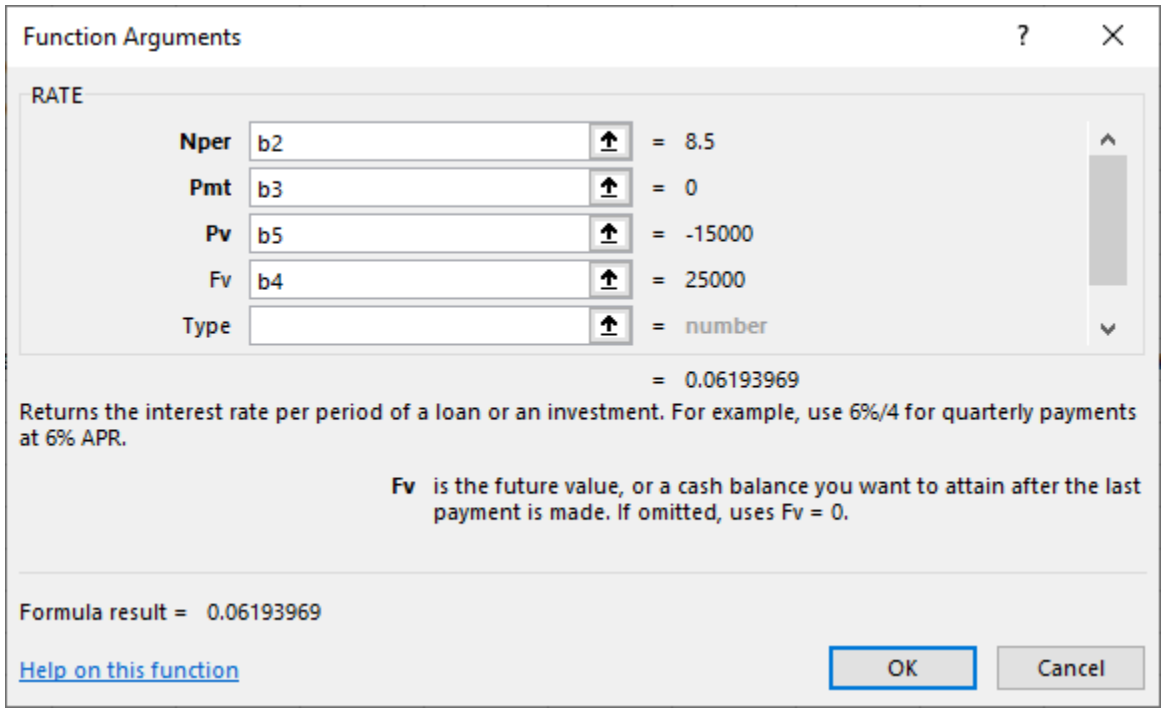


**Figure 7.16 Completed Dialog Box for RATE Function Arguments**

As in our other examples, cell values are shown as numerical values off to the right, and our answer of approximately 0.0619, or 6.19%, is shown at the bottom of the dialog box.

This answer also can be checked from a logic point of view because of the similar example we worked through when calculating periods of time. Our present value and future value are the same as in that example, and our time period is now 8.5 years, which is just under the result we arrived at (8.77 years) in

the periods example.

So, if we are now working with a slightly shorter time frame for the savings to grow from $15,000 into $25,000, then we would expect to have a slightly greater growth rate. That is exactly how the answer turns out, as the calculated required interest rate of approximately 6.19% is just slightly greater than the growth rate of 6% used in the previous example. So, based on this, it looks like our answer here passes a simple "sanity check" review.

# 7.4 Applications of TVM in Finance

## Learning Outcomes

By the end of this section, you will be able to:

- Explain how the time value of money can impact your personal financial goals.
- Explain how the time value of money is related to inflation.
- Explain how the time value of money is related to financial risk.
- Explain how compounding period frequency affects the time value of money.

## Single-Period Scenario

Let's say you want to buy a new car next year, and the one you have your eye on should be selling for $20,000 a year from now. How much will you need to put away today at 5% interest to have $20,000 a year from now? Essentially, you are trying to determine how much $20,000 one year from now is worth today at 5% interest over the year. To find a present value, we reverse the growth concept and lower or *discount* the future value back to the current period.

The interest rate that we use to determine the present value of a future cash flow is referred to as the **discount rate** because it is bringing the money back in time in terms of its value. The discount rate refers to the annual rate of reduction on a future value and is the inverse of the growth rate. Once we know this discount rate, we can solve for the present value (PV), the value today of tomorrow's cash flow. By changing the FV equation, we can turn

$$\text{FV} = \text{PV} \times (1+r)^n \tag{7.31}$$

into

$$\text{PV} = \text{FV} \times \frac{1}{(1+r)^n} \tag{7.32}$$

which is the present value equation. The fraction shown above is referred to as the present value interest factor (PVIF). The PVIF is simply the reciprocal of the FVIF, which makes sense because these factors are doing exactly opposite things. Therefore, the amount you need to deposit today to earn $20,000 in one year $(n = 1)$ at 5% interest is

$$\$20{,}000 \times \frac{1}{(1.05)^1} = \$20{,}000 \times 0.95238 = \$19{,}047.62 \tag{7.33}$$

## The Multiple-Period Scenario

There will often be situations when you need to determine the present value of a cash flow that is scheduled to occur several years in the future (see Figure 7.17). We can again use the formula for present value to calculate a value today of future cash flows over multiple time periods.

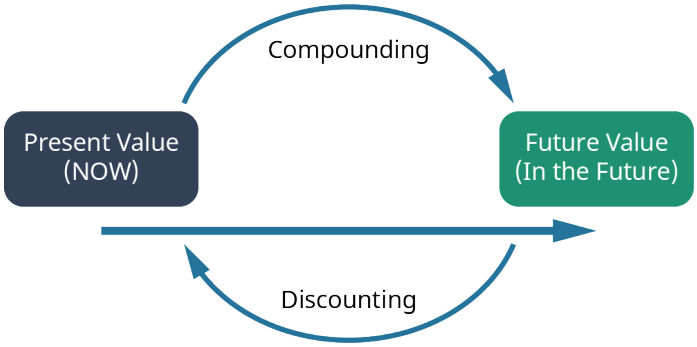


**Figure 7.17 Determining Future Cash Flow**

An example of this would be if you wanted to buy a savings bond for Charlotte, the daughter of a close friend. The face value of the savings bond you have in mind is $1,000, which is the amount Charlotte would receive in 30 years (the future value). If the government is currently paying 5% per year on savings bonds, how much will it cost you today to buy this savings bond?

The $1,000 face value of the bond is the future value, and the number of years *n* that Charlotte must wait to get this face value is 30 years. The interest rate *r* is 5.0% and is the discount rate for the savings bond. Applying the present value equation, we calculate the current price of this savings bond as follows:

$$\text{PV} = \$1{,}000 \times \frac{1}{(0.05)^{30}} = \$1{,}000 \times 0.231377 = \$231.38 \quad \textbf{7.34}$$

So, it would cost you $231.38 to purchase this 30-year, 5%, $1,000 face-valued bond.

What we have done in the above example is reduce, or discount, the future value of the bond to arrive at a value expressed in today's dollars. Effectively, this discounting process is the exact opposite of compounding interest that we covered earlier in our discussion of future value.

An important concept to remember is that *compounding* is the process that takes a present valuation of money to some point in the future, while *discounting* takes a future value of money and equates it to present dollar value terms.

Common applications in which you might use the present value formula include determining how much money you would need to invest in an interest-bearing account today in order to finance a college education for your oldest child and how much you would need to invest today to meet your retirement plans 30 years from now.

## TVM, Inflation, Compounding Interest, Investing, Opportunity Costs, and Risk

The time value of money (TVM) is a critical concept in understanding the value of money relative to the amount of time it is held, saved, or invested. The TVM concept and its specific applications are frequently used by individuals and organizations that might wish to better understand the values of financial assets and to improve investing and saving strategies, whether these are personal or within business environments.

As we have discussed, the key element behind the concept of TVM is that a given amount of money is worth more today than that same amount of money will be at any point in the future. Again, this is because money can be saved or invested in interest-bearing accounts or investments that will generate interest income over time, thus resulting in increased savings and dollar values as time passes.

### Inflation

Inflation is defined as a general increase in the prices of goods and services and/or a drop in the value of money and its purchasing power.

The purchasing power of the consumer dollar is a statistic tracked by the part of the US Bureau of Labor Statistics and is part of the consumer price index (CPI) data that is periodically published by that government agency. In a way, purchasing power can be viewed as a mirror image or exact opposite of inflation or increases in consumer prices, as measured by the CPI. Figure 7.18 demonstrates the decline in the purchasing power of the consumer dollar over the 13-year period from 2007 to 2020.

With this in mind, we can work with the TVM formula and use it to help determine the present value of money you have in hand today, as well as how this same amount of money may be valued at any specific point in the future and at any specific rate of interest.

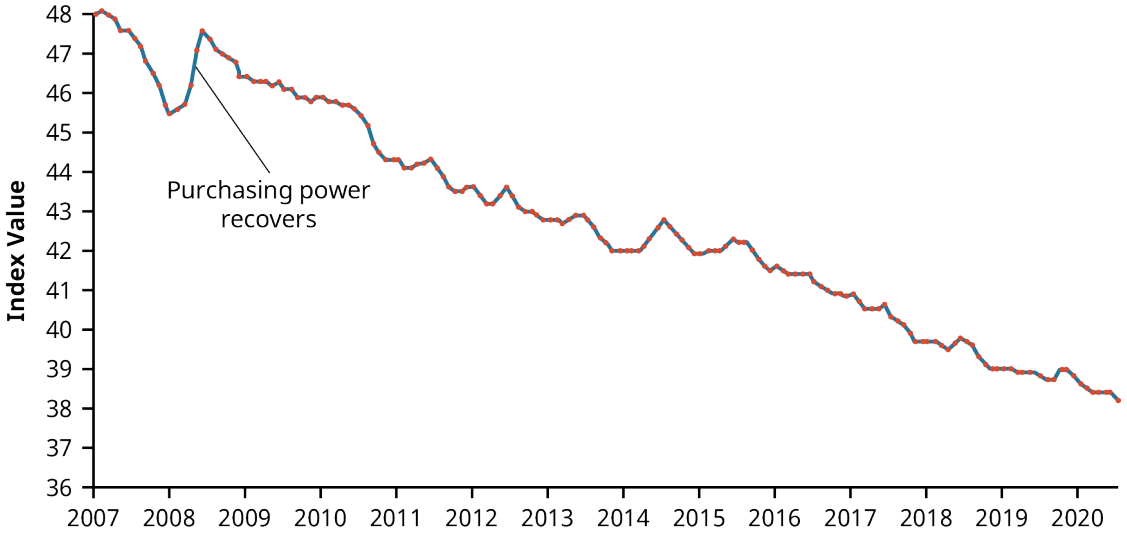


**Figure 7.18 Historical Purchasing Power Decline as a Result of Inflation, 2007–2020** (data source: Bureau of Labor Statistics)

## The Relationship between TVM and Inflation

As we have seen, the future value formula can be very helpful in calculating the value of a sum of cash (or any **liquid asset**) at some future point in time. One of the important ideas relating to the concept of TVM is that it is preferable to spend money today instead of at some point in the future (all other things being equal) when inflation is positive. However, in very rare instances in our economy when inflation is negative, spending money later is preferable to spending it now. This is because in cases of negative inflation, the purchasing power of a dollar is actually greater in the future, as the costs of goods and services are declining as we move into the future.

Most investors would be inclined to take a payment of money today rather than wait five years to receive a payment in the same amount. This is because inflation is almost always positive, which means that general prices of goods and services tend to increase over the passage of time. This is a direct function and result of normal economic growth. The crux of the concept of TVM is directly related to maintaining the present value of financial assets or increasing the value of these financial assets at different points in the future when they may be needed to obtain goods and services. If a consumer's monetary assets grow at a greater rate than inflation over any period of time, then the consumer will realize an increase in their overall purchasing power. Conversely, if inflation exceeds savings or investment growth, then the consumer will lose purchasing power as time goes by under such conditions.

## The Impact of Inflation on TVM

The difference between present and future values of money can be easily seen when considered under the effects of inflation. As we discussed above, inflation is defined as a state of continuously rising prices for goods and services within an economy. In the study of economics, the laws of supply and demand state that increasing the amount of money within an economy without increasing the amount of goods and services available will give consumers and businesses more money to spend on those goods and services. When more

money is created and made available to the consuming public, the value of each unit of currency will diminish. This will then have the effect of incentivizing consumers to spend their money now, or in the very near future, instead of saving cash for later use. Another concept in economics states that this relationship between **money supply** and monetary value is one of the primary reasons why the **Federal Reserve** might at times take steps to inject money into a stagnant, lethargic economy. Increasing the money supply will lead to increased economic activity and consumer spending, but it can also have the negative effect of increasing the costs of goods and services, furthering an increase in the rate of inflation.

Consumers who decide to save their money now and for the foreseeable future, as opposed to spending it now, are simply making the economic choice to have their cash on hand and available. So, this ends up being a decision that is made despite the risk of potential inflation and perhaps losing purchasing power. When inflationary risk is low, most people will save their money to have it available to spend later. Conversely, in times when inflationary risk is high, people are more likely to spend their money now, before its purchasing power erodes. This idea of inflationary risk is the primary reason why savers and investors who decide to save now in order to have their money available at some point in the future will insist they are paid, through interest or return on investment, for the future value of any savings or financial instrument.

Lower interest rates will usually lead to higher inflation. This is because, in a way, interest rates can be viewed as the cost of money. This allows for the idea that interest rates can be further viewed as a tax on holding on to sums of money instead of using it. If an economy is experiencing lower interest rates, this will make money less expensive to hold, thus incentivizing consumers to spend their money more frequently on the goods and services they may require. We have also seen that the more quickly inflation rates rise, the more quickly the general purchasing power of money will be eroded. Rational investors who set money aside for the future will demand higher interest rates to compensate them for such periods of inflation. However, investors who save for future consumption but leave their money **uninvested** or **underinvested** in low-interest-bearing accounts will essentially lose value from their financial assets because each of their future dollars will be worth less, carrying less purchasing power when they end up needing it for use. This relationship of saving and planning for the future is one of the most important reasons to understand the concept of the time value of money.

## Nominal versus Real Interest Rates

One of the main problems of allowing inflation to determine interest rates is that current interest rates are actually nominal interest rates. Nominal rates are "stated," not adjusted for the effects of inflation. In order to determine more practical **real interest rates**, the original nominal rate must be adjusted using an inflation rate, such as those that are calculated and published by the **Bureau of Labor Statistics** within the **consumer price index (CPI)**.

A concept referred to as the **Fisher effect**, named for economist Irving Fisher, describes the relationship between inflation and the nominal and real interest rates and is expressed using the following formula:

$$(1 + i) = (1 + R) \times (1 + h) \tag{7.35}$$

where $i$ is the nominal interest rate, $R$ is the real interest rate, and $h$ is the expected inflation rate.

An example of the Fisher effect would be seen in the case of a bond investor who is expecting a real interest rate of return of 6% on the bond, in an economy that is experiencing an expected inflation rate of 2%. Using the above formula, we have

$$\begin{aligned} i &= (1 + R) \times (1 + h) - 1 \\ i &= (1 + 6\%) \times (1 + 2\%) - 1 \\ i &= 8.12\% \end{aligned} \tag{7.36}$$

So, the nominal interest rate on the bond amounts to 8.12%, with a real interest rate of 6% within an economy that is experiencing a 2% inflation rate. This is a logical result because in a scenario of positive inflation, a real rate of return would always be expected to amount to less than the stated or nominal rate.

## Interest and Savings

Savings are adversely affected by negative real interest rates. A person who holds money in the form of cash is actually losing future purchasing value when real interest rates are negative. A saver who decides to hold $1,000 in the form of cash for one year at a negative real interest rate of −3.65% per year will lose $\$1{,}000 \times -0.0365$ or $36.50, in purchasing power by the end of that year.

Ordinarily, interest rates would rise to compensate for negative real rates, but this might not happen if the Federal Reserve takes steps to maintain low interest rates to help stimulate and stabilize the economy. When interest rates are at such low levels, investors are forced out of Treasury and **money market investments** due to their extremely poor returns.

It soon becomes obvious that the time value of money is a critical concept because of its tremendous and direct impact on the daily spending, saving, and investment decisions of the people in our society. It is therefore extremely important that we understand how TVM and government fiscal policy can affect our savings, investments, purchasing behavior, and our overall personal financial health.

## Compounding Interest

As we discussed earlier, compound interest can be defined as interest that is being earned on interest. In cases of **compounding interest**, the amount of money that is being accrued on previous amounts of earned interest income will continue to grow with each **compounding period**. So, for example, if you have $1,000 in a savings account and it is earning interest at a 10% annual rate and is compounded every year for a period of five years, the compounding will allow for growth after one year to an amount of $1,100. This comprises the original principal of $1,000 plus $100 in interest. In year two, you would actually be earning interest on the total amount from the previous compounding period—the $1,100 amount.

So, to continue with this example, by the end of year two, you would have earned $1,210 ($1,100 plus $110 in interest). If you continue on until the end of year five, that $1,000 will have grown to approximately $1,610. Now, if we consider that the highest annual inflation rate over the last 20 years has been 3%, then in this scenario, choosing to invest your present money in an account where interest is being compounded leaves you in a much better position than you would be in if you did not invest your money at all. The concept of the time value of money puts this entire idea into context for us, leading to more informed decisions on personal saving and investing.

It is important to understand that interest does not always compound annually, as assumed in the examples we have already covered. In some cases, interest can be compounded quarterly, monthly, daily, or even continuously. The general rule to apply is that the more frequent the compounding period, the greater the future value of a savings amount, a bond, or any other financial instrument. This is, of course, assuming that all other variables are constant.

The math for this remains the same, but it is important that you be careful with your treatment and usage of rate (*r*) and number of periods (*n*) in your calculations.

For example, $1,000 invested at 6% for a year compounded annually would be worth $\$1{,}000 \times (1.06)^1 = \$1{,}060.00$. But that same $1,000 invested for that same period of time—one year—and earning interest at the same annual rate but compounded monthly would grow to $\$1{,}000 \times (1.005)^{12} = \$1{,}061.67$, because the interest paid each month is earning interest on interest at a 6% rate. Note that we represent *r* as the interest paid per period $\left(\frac{\text{0.06 annual interest}}{\text{12 months in a year}} = 0.005\right)$ and *n* as the number of periods (12 months in a year; $12 \times 1 = 12$) rather than the number of years, which is only one.

Continuing with our example, that same $1,000 in an account with interest compounded quarterly, or four times a year, would grow to $\$1{,}000 \times (1.015)^4 = \$1{,}061.36$ in one year. Note that this final amount ends up being greater than the annually compounded future value of $1,060.00 and slightly less than the monthly

compounded future value of $1.061.67, which would appear to make logical sense.

The total differences in future values among annual, monthly, and quarterly compounding in these examples are insignificant, amounting to less than $1.70 in total. However, when working with larger amounts, higher interest rates, more frequent compounding periods, and longer terms, compounding periods and frequency become far more important and can generate some exceptionally large differences in future values.

Ten million dollars at 12% growth for one year and compounded annually amounts to $\$10{,}000 \times (1.12) = \$11{,}200{,}000$, while 10 million dollars on the same terms but compounded quarterly will produce $\$10{,}000{,}000 \times (1.03)^4 = \$11{,}255{,}088.10$. Most wealthy and rational investors and savers would be very pleased to earn that additional $55,088.10 by simply having their funds in an account that features quarterly compounding.

In another example, $200 at 60% interest, compounded annually for six years, becomes $\$200 \times (1.6)^6 = \$3{,}355.44$, while this same amount compounded quarterly grows to $\$200 \times (1.15)^{24} = \$5{,}725.04$.

An amount of $1 at 3%, compounded annually for 100 years, will be worth $\$1 \times (1.03)^{100} = \$19.22$. The same dollar at the same interest rate, compounded monthly over the course of a century, will grow to $\$1 \times (1.0025)^{1{,}200} = \$397.44$.

This would all seem to make sense due to the fact that in situations when compounding increases in frequency, interest income is being received during the year as opposed to at the end of the year and thus grows more rapidly to become a larger and more valuable sum of money. This is important because we know through the concept of TVM that having money now is more useful to us than having that same amount of money at some later point in time.

## The Rule of 72

The rule of 72 is a simple and often very useful mathematical shortcut that can help you estimate the impact of any interest or growth rate and can be used in situations ranging from financial calculations to projections of population growth. The formula for the rule of 72 is expressed as the unknown (the required amount of time to double a value) calculated by taking the number 72 and dividing it by the known interest rate or growth rate. When using this formula, it is important to note that the rate should be expressed as a whole integer, not as a percentage. So, as a result, we have

$$\text{Years for an Amount to Double} = \frac{72}{\text{Interest or Growth Rate}} \tag{7.37}$$

This formula can be extremely practical when working with financial estimates or projections and for understanding how compound interest can have a dramatic effect on an original amount or monetary balance.

Following are just a few examples of how the rule of 72 can help you solve problems very quickly and very easily, often enabling you to solve them “in your head,” without the need for a calculator or spreadsheet.

Let’s say you are interested in knowing how long it will take your savings account balance to double. If your account earns an interest rate of 9%, your money will take $72/9$ or 8, years to double. However, if you are earning only 6% on this same investment, your money will take $72/6$, or 12, years to double.

Now let’s say you have a specific future purchasing need and you know that you will need to double your money in five years. In this case, you would be required to invest it at an interest rate of $72/5$, or 14.4%. Through these sample examples, it is easy to see how relatively small changes in a growth or interest rate can have significant impact on the time required for a balance to double in size.

To further illustrate some uses of the rule of 72, let’s say we have a scenario in which we know that a country’s **gross domestic product** is growing at 4% a year. By using the rule of 72 formula, we can determine that it will

take the economy 72/4, or 18, years to effectively double.

Now, if the economic growth slips to 2%, the economy will double in $72/2$, or 36, years. However, if the rate of growth increases to 11%, the economy will effectively double in $72/11$, or 6.55, years. By performing such calculations, it becomes obvious that reducing the time it takes to grow an economy, or increasing its rate of growth, could end up being very important to a population, given its current level of technological innovation and development.

It is also very easy to use the rule of 72 to express future costs being impacted by inflation or future savings amounts that are earning interest.

To apply another example, if the inflation rate in an economy were to increase from 2% to 3%, consumers would lose half of the purchasing power of their money. This is calculated as the value of their money doubling in $72/3$, or 24, years as compared to $72/2$, or 36, years—quite a substantial difference.

Now, let's say that tuition costs at a certain college are increasing at a rate of 7% per year, which happens to be greater than current inflation rates. In this case, tuition costs would end up doubling in $72/7$, or about 10.3, years.

In an example related to personal finance, we can say that if you happen to have an annual percentage rate of 24% interest on your credit card and you do not make any payments to reduce your balance, the total amount you owe to the credit card company will double in only $72/24$, or 3, years.

So, as we have seen, the rule of 72 can clearly demonstrate how a relatively small difference of 1 percentage point in GDP growth or inflation rates can have significant effects on any short- or long-term economic forecasting models.

It is important to understand that the rule of 72 can be applied in any scenario where we have a quantity or an amount that is in the process of growing or is expected to grow for any period of time into the future. A good nonfinancial use of the rule of 72 might be to apply it to some population projections. For example, an increase in a country's population growth rate from 2% to 3% could present a serious problem for the planning of facilities and infrastructure in that country. Instead of needing to double overall economic capacity in $72/2$ or 36, years, capacity would have to be expanded in only $72/3$, or 24, years. It is easy to see how dramatic an effect this would be when we consider that the entire schedule for growth or infrastructure would be reduced by 12 years due to a simple and relatively small 1% increase in population growth.

## Investing and Risk

Investing is usually a sound financial strategy if you have the money to do so. When investing, however, there are certain risks you should always consider first when applying the concepts of the time value of money. For example, making the decision to take $1,000 and invest it in your favorite company, even if it is expected to provide a 5% return each year, is not a guarantee that you will earn that return—or any return at all, for that matter. Instead, as with any investment, you will be accepting the risk of losing some or even all of your money in exchange for the opportunity to beat inflation and increase your future overall wealth. Essentially, it is risk and return that are responsible for the entire idea of the time value of money.

Risk and return are the factors that will cause a rational person to believe that a dollar risked should end up earning more than that single dollar.

To summarize, the concept of the time value of money and the related TVM formulas are extremely important because they can be used in different circumstances to help investors and savers understand the value of their money today relative to its earning potential in the future. TVM is critical to understanding the effect that inflation has on your money and why saving your money early can help increase the value of your savings dollars by giving them time to grow and outpace the effects of inflation.

## Opportunity Costs

The concept of **opportunity cost** arises from the idea that there will always be possible options that are sacrificed with every option we decide on or for every choice that we make. For example, let's consider the decision to go to college after you graduate from high school. This decision, as with just about any other, will involve evaluating opportunity costs. If you choose to go to college, this will result in your sacrificing four years of potential earnings that you could have had if you had decided to take a job instead of attending school. Also, in addition to the lost salary, you would be losing out on four years of work experience that could have had a positive impact on your résumé or your future earnings prospects.

Of course, the entire idea behind furthering one's education is that you are hopeful that by choosing to go to college, you will increase the likelihood of earning a greater salary over the course of your lifetime than you would have if you had chosen to join the workforce directly out of high school. So, this ends up being a bit of a risk, but one that you have considered. The idea is that you are hoping for a more significant payoff down the road than if you had made the decision not to continue with your studies. When it comes to opportunity costs and the time value of money, it is obvious that there will always be costs associated with every forgone financial opportunity we pass on when we make a different choice. The logical individual can only hope that these choices produce a better end result than if we had made different choices and pursued any of our forgone alternatives. This also applies in situations where we may sit idly by and decide to take no action at all.

For example, if you are putting $1,000 in a savings account to save for a house, you may be giving up an opportunity to grow that money in an investment account that would earn a greater rate of return. In another example, being able to calculate the future value of your money will tell you that instead of investing, you probably should be paying down your 24% APR credit card debt that is costing you hundreds of dollars a month—hundreds of dollars more than you might earn from an investment account.

# Summary

## 7.1 Now versus Later Concepts

This section discussed the underlying concepts of the time value of money (TVM). Because it is possible to earn interest income on cash that you decide to deposit in an investment or an interest-bearing account, money that you have now or receive sooner will be more valuable to you than the same amount of money received later.

## 7.2 Time Value of Money (TVM) Basics

Future value refers to the value that a current amount will eventually grow into at a given interest rate over a specific period of time. The single-period scenario is one way in which future amounts are calculated. Compounding, which is interest earned on interest, also affects the future value of money.

## 7.3 Methods for Solving Time Value of Money Problems

Calculations can be used to determine future and present dollar amounts, discount and growth rates, and periods of time required for specific growth. Time value of money problems can be solved using mathematical equations, calculators with financial functions, and spreadsheets. A useful tool for conceptualizing present value and future value problems is a timeline. A timeline is a visual, linear representation of the timing of periods and cash flows over a set amount of time.

## 7.4 Applications of TVM in Finance

The idea of the time value of money is often considered to be the cornerstone concept of the study of finance. TVM can help investors and savers understand the value of money today relative to its earning potential in the future. TVM is critical to understanding the effect that inflation has on money and why saving your money early can help increase the value of your savings dollars by giving them time to grow and outpace the effects of inflation. Of course, it is important to remember that there will always be possible options that are sacrificed with every option you decide on and every choice you make.

# Key Terms

**Bureau of Labor Statistics** a group within the United States Department of Labor that is the primary fact-finding agency for the US government in the fields of labor, statistics, and economics; serves as the principal agency of the US Federal Statistical System

**compounding interest** the continual addition of interest to the original principal sum of a loan or deposit, often referred to as interest on interest

**compounding period** the period between points in time when interest is paid or added to the principal

**consumer price index (CPI)** a measure that examines the weighted average of prices of a basket of consumer goods and services such as transportation, food, and medical care

**discount rate** the interest rate used to determine the present value of future cash inflows

**Federal Reserve** the central bank system of the United States

**financial instrument** an asset or bundle of assets, including monetary contracts between parties, that can be bought, sold, or traded for financial gain

**financial risk** the possibility of losing money or purchasing power on an investment, business transaction, or venture or simply due to inflation

**Fisher effect** an economic theory created by economist Irving Fisher that describes the relationship between inflation and both real and nominal interest rates

**future value (FV)** the value that a current amount will grow to at a given interest rate over a given period of time

**gross domestic product (GDP)** the total value of goods produced and services provided in a country during one year

**growth rate** the percentage increase of a specific variable within a specific time period; synonymous with *interest rate* in the context of the time value of money

**interest** the amount of money that is paid by a borrower to a lender for the use of their money, typically calculated from an annualized rate

**investment** an asset or item acquired with the goal of generating financial gain through increased income or appreciation in value

**liquid asset** an asset that can be readily converted into cash within a short period of time

**money market investments** low-risk financial instruments such as T-bills, federal notes, commercial paper, certificates of deposit (CDs), repurchase agreements (repos), and bankers' acceptances, among others

**money supply** the total dollar value of legal tender that is available to consumers within an economy at any single point in time

**opportunity cost** the loss of potential gain from other alternatives when a single alternative is chosen

**present value (PV)** the current value of a future amount, calculated by discounting the future value back at a known discount or interest rate for a specified period of time

**real interest rate** a rate of interest that has been adjusted to account for the effects of inflation

**single payment or lump sum** a single payment or deposit made at one time, as opposed to a number of smaller payments or deposits made in installments

**time value of money (TMV)** the concept that an amount of money is worth more today than the exact same amount of money at some point in the future

**Treasury investments** debt obligations such as T-bills (Treasury bills), bonds, and notes issued by the US Department of the Treasury

**underinvested** describes an insufficient amount of investment or an investment that is earning an insufficient rate of interest

**uninvested** describes cash that is being held in reserve, is not invested in an account or financial instrument, and is not earning interest or any return

## CFA Institute

This chapter supports some of the Learning Outcome Statements (LOS) in this CFA® Level I Study Session (https://openstax.org/r/cfainstitute_link). Reference with permission of CFA Institute.

## Multiple Choice

1. The most basic type of financial transaction involves _____.
   **a.** an amount of money that is not invested
   **b.** a series of equal installment amounts paid or received over a period of time
   **c.** a simple, one-time amount of cash that can be either a receipt or a payment
   **d.** None of the above

2. If a discount (or interest) rate has a positive value, then the future value of any amount deposited in an interest-bearing account will _____.
   **a.** be less than the present value
   **b.** be equal to the present value
   **c.** be greater than the present value
   **d.** decline over time

3. If the discount (or interest) rate used to calculate the present value of a future payment increases, the calculated present value will do which of the following?
   **a.** Increase
   **b.** Decrease
   **c.** Remain the same
   **d.** Increase as the period of time shortens

4. The discount rate that is required to equate a future payment of $500 in three years to a present value of $400 is _____.
   **a.** 4.7%
   **b.** 6.5%
   **c.** 7.7%
   **d.** 8.8%

5. If compounding periods increase in frequency and all else remains the same, the dollar values of any resulting future value calculations will _____.
   **a.** increase
   **b.** remain the same
   **c.** decrease
   **d.** None of the above

## Review Questions

1. All other things being the same, would you prefer a bank account that compounds interest quarterly or one that compounds interest semiannually?
2. Briefly describe the concept of future value within the context of the larger overall concept of the time value of money.
3. Which of the following two options will give you the greatest future value: (A) an initial deposit of $100 earning 20% per year, compounded annually and left to grow for 10 years, or (B) an initial deposit of $75 earning 12% per year, compounded monthly and left to grow for 15 years?
4. If a savings account pays interest on a quarterly basis and you are performing future value calculations on deposited amounts, how can you calculate the rate?
5. Briefly describe the relationship among consumer savings, purchasing power, and inflation.

## Problems

1. Find the future value of $100 in five years at 5% interest.
2. Find the future value of $1,800 in 3 years at 8% interest.
3. How much would you have to deposit now to have $15,000 in eight years if interest is 7%?
4. What is the present value of $5,000 that will be paid to you eight years from today at 8% interest?
5. How many years will it take a $700 balance to grow into $900 in an account earning 5%?
6. If you borrow $1,000 and pay back $1,728 in three years, what annual rate of interest are you paying?
7. How long will it take you to triple your money at 8%?
8. A company's sales were $250 million in 2019. If sales grow at 6% per year, how large will they be 10 years later, in 2029 (as expressed in millions)?
9. A US government bond in the amount of $1,000 will mature in six years, has no coupon payments, and carries an interest rate of 8%. What is the value of this bond today?
10. You spend $725.00 to purchase a $1,000 bond that will have no coupon payments and matures in 12 years. What interest rate will you be earning on this bond?
11. At what interest rate would you be ambivalent about receiving either $50,000 10 years from now or $35,000 today?
12. Vance Corporation had earnings last year of $3.25 per share. The company has experienced 8% annual

growth over the last several years, and management expects that growth rate to continue. Based on this information, after how long will earnings per share double?

**13.** What is the amount of total interest dollars earned on a $5,000 deposit earning 6% for 20 years?

**14.** You have decided that you will sell your $300,000 house when it appreciates in value to $500,000. If houses are appreciating at an average annual rate of 5% in your neighborhood, for approximately how long will you be staying in your house?

**15.** You just won some money in the lottery and would like to save a portion of it so that you will have $50,000 to put a down payment on a house in five years. Your bank pays a 5% rate of interest. How much money will you have to set aside from the lottery winnings?

**16.** Bauer Bookstore sells books before they are published. Today, they offered the book *Journeys in Finance* for $14.20, but the book will not be published for another two years. Upon publishing, the price of the book will be $24.00. What is the discount rate Bauer Bookstore is offering its customers for this book?

**17.** One of your professional goals is to one day earn a six-figure salary ($100,000). You hope to accomplish this objective within the next 30 years. Salaries grow at 3.75% per year in your field of work. What beginning salary will you need in order to reach this 30-year goal?

**18.** How much will $25,000 grow to in five years at a 5% annual rate that is compounded quarterly?

**19.** If Eisenberg Industries revenues have increased from $30 million to $90 million over a 10-year period, what has been their annual rate of growth?

**20.** If you are scheduled to receive $4,000 six years from today and the discount rate is 8.5%, what is the present value of this payment?

**21.** If you were to open a savings account that earns 3% interest and is compounded quarterly, what would be the total amount in your account after 10 years if you made an opening deposit of $9,500?

**22.** You are considering four possible options for your new savings account. You plan to deposit $13,000 and leave this amount in the account for 20 years with no additional deposits or withdrawals. All of these account options would earn 6% interest, but each one has a different compounding frequency, listed below. What would be the value of each account at the end of the 20-year period?

a. Annually
b. Semiannually
c. Quarterly
d. Monthly

## Video Activity

### Time Value of Money Calculations with Financial Calculator

Access multimedia content (http://openstax.org/books/principles-finance/pages/7-video-activity)

**1.** Name and describe the five primary keys on a financial calculator that are used to solve time value of money problems.

**2.** Following the instructions laid out in this video, practice calculating the following TVM variables using these inputs:
Find a Future Value (FV): Calculate FV when

$$\text{PV} = -1{,}000,\ \text{N} = 5,\ \text{I/Y} = 4, \text{ and } \text{PMT} = 0.$$

Find a Present Value (PV): Calculate PV when

$\text{FV} = 2{,}000,\ \text{N} = 7,\ \text{I/Y} = 5$, and $\text{PMT} = 0$.

Find the Number of Periods (N) when

$\text{FV} = 5{,}000,\ \text{PV} = -3{,}000,\ \text{I/Y} = 3$, and $\text{PMT} = 0$.

Find the Interest Rate (I/Y) when

$\text{FV} = 6{,}000,\ \text{PV} = -1{,}500,\ \text{N} = 10$, and $\text{PMT} = 2$.

Find the Payment (PMT) when

$\text{FV} = 15{,}000,\ \text{PV} = -8{,}000,\ \text{N} = 12$, and $\text{I/Y} = 4$.

Continue to practice using a financial calculator to solve various time value of money problems using different input factors until you feel comfortable with the process of using a calculator to solve TVM problems.

## Time Value of Money Using Excel with 10 Examples

Access multimedia content (http://openstax.org/books/principles-finance/pages/7-video-activity)

3. Where within the Excel spreadsheet and its different menus (under what menu button option) can you find the different functions that will enable you to solve for different time value of money factors?

4. Following the instructions laid out in this video, practice calculating the following TVM variables in Excel.
Find a Future Value (FV): Calculate FV when

$\text{PV} = -1{,}000,\ \text{N} = 5,\ \text{I/Y} = 4$, and $\text{PMT} = 0$.

Find a Present Value (PV): Calculate PV when

$\text{FV} = 2{,}000,\ \text{N} = 7,\ \text{I/Y} = 5$, and $\text{PMT} = 0$.

Find the Number of Periods (N) when

$\text{FV} = 5{,}000,\ \text{PV} = -3{,}000,\ \text{I/Y} = 3$, and $\text{PMT} = 0$.

Find the Interest Rate (I/Y) when

$\text{FV} = 6{,}000,\ \text{PV} = -1{,}500,\ \text{N} = 10$, and $\text{PMT} = 2$.

Find the Payment (PMT) when

$\text{FV} = 15{,}000,\ \text{PV} = -8{,}000,\ \text{N} = 12$, and $\text{I/Y} = 4$.

Go back and check the answers to these questions that you ended up with under the video *Time Value of Money Calculations with Financial Calculator*. You should get the exact same answers when using both methods (calculator and Excel).

Continue to practice using Excel to solve various time value of money problems using different input factors until you feel comfortable with the process of using spreadsheets to solve TVM problems.

8

# Time Value of Money II: Equal Multiple Payments

**Figure 8.1** The value of an investment generally represents our expectations of all future cash flows from that investment, once discounted. (credit: modification of "Money" by Ervins Strauhmanis/flickr CC BY 2.0)

## Chapter Outline


**8.1** Perpetuities
**8.2** Annuities
**8.3** Loan Amortization
**8.4** Stated versus Effective Rates
**8.5** Equal Payments with a Financial Calculator and Excel


## Why It Matters

Although this text is directed at business finance students, our daily decisions as consumers are largely based on money and finance to just as great an extent. An old adage in finance claims, "If you aren't in control of your money, your money is controlling you." Fortunately, learning to manage your money is not difficult if you're disciplined and understand some simple techniques. For example, several years ago, the author was negotiating for a three-year auto loan from a well-known regional dealer, who was offering an interest rate of 2%. When the manager left the room for a few minutes, we pulled out a financial calculator and proved in less than a minute that the actual interest rate in the payments he was proposing was nearly double the quoted and advertised rate.

In addition to understanding how the loan process works, which improves your negotiation skills when borrowing, businesses and individuals can better control their investments by understanding basic rules of finance, particularly as seen in this and the preceding chapter. Assume you pledge to invest $1,000 per year at 5% return per year and are curious about how much you will have accumulated by age 60. If you begin at age 30, you will have $69,760; if you begin at age 20, you will have $126,840. Can the extra 10 years make that much of a difference? We'll see that indeed they can, and the calculations required to prove it can take less than two minutes.

As another example, many professionals confuse *income* and *wealth* during their career growth. In their popular book *The Millionaire Next Door: The Surprising Secrets of America's Wealthy*, authors Thomas Stanley and William Danko illustrate these terms with a flowing river. A river is in constant movement, and as the flow

or depth increases, this is comparable to one's income increasing through the promotions, salary increases, and bonuses one receives. Unfortunately, many individuals then increase their spending habits in response, justifying a better car, a second home, or more lavish vacations. Wealth, in contrast, is comparable to taking a bucket of water from the river and holding it aside in a tank for oneself. Financial professionals often call this "paying yourself first." Stanley and Danko list this among the "secrets" referenced in the title of their book.

# 8.1 Perpetuities

## Learning Outcomes

By the end of this section, you will be able to:

- Define perpetuity.
- Explain how perpetuities are valued.

In Time Value of Money I, we learned that the value of money changes with the passage of time. Decision-makers consider how investments, projects, and even opportunity costs gain value as we move forward into the future. They similarly consider how value in the future can be reduced to a value in present or past periods. We saw that these value projections are called determination of future value (compounding, moving forward on a timeline) or present value (discounting, moving backward on a timeline). The easiest way to visualize this movement through time, whether forward or backward, is by use of a timeline.

Throughout the first chapter on the time value of money, we were analyzing a single amount. In this chapter, we deal with a stream of payments made periodically—in other words, payments made or received regularly over a span of time. We begin with the illustration of a perpetuity.

## What Is a Perpetuity?

A **perpetuity** is a series of payments or receipts that continues forever, or perpetually. One of the best ways to analyze the basics of an *annuity* (the stream of payments to be paid or received in the future) is by starting with a perpetuity. The most common examples of perpetuities in the author's experience are college chair endowments and preferred stock.

If you gift $1,500,000 to a college to name a professor's chair for your family, you might specify that the money must be held in perpetuity and invested by the college to yield a fixed 3%. The college will take those proceeds of the investment, leaving your original $1,500,000 intact, and use the annual interest of $45,000 to fund a portion of the professor's salary.

Another common example is **preferred stock**. Most preferred stock issues carry a fixed and predetermined rate of dividend. If we assume that the dividend will not change in future years, then preferred dividend shareholders will receive a fixed amount of money in future years—assuming, of course, that the company's board of directors declares the dividends sufficient to fund these requirements. If we assume that the dividend is declared and paid and that it remains constant, this represents a perpetuity.

For example, Shaw Inc. has issued 100,000 shares of preferred stock with a stated value of $50 and a 4% dividend. Therefore, if they can fund and decide to declare dividends for the full amount, they will pay out $200,000, or $2.00 per preferred share. Because shares such as these are created with the intention of continuity, the owner of this preferred stock can theoretically expect this dividend income stream in perpetuity.

To place a current market value on this stream of future income, how much should an investor pay for one share of this preferred stock? The calculation is a present value. The amount the investor pays today for that one share is equal to the annual dividend (assuming it is declared and paid) divided by the rate of return. But be careful—it is not the rate on the face of the preferred stock but the **required rate of return**, the "market rate" that investors expect from a stock of this level of risk. We must also note an important fact affecting all investment valuations: the value of an investment generally represents our expectations of all future cash flows from that investment, discounted to today's dollars.

Because a perpetuity is a stream of payments continuing indefinitely, determining the future value isn't possible. Determining the present value, however, *is* possible, although one might wonder how. As we learned earlier, the greater the amount of time used in a present value calculation, the smaller the amount of dollars needed at the beginning, regardless of the interest rate involved. Therefore, when we discount each payment in an infinite series, remembering that we would then add them together once we discount them to the present, the infinite payments become negligible at some point and will no longer have a significant impact on today's value. To grow to one dollar 70 years from now, even at a growth rate of 5% per year, we would only need $0.0329—not even four cents. Keeping all other facts the same, if we had 100 years to grow an investment to one dollar, we would only need 0.76 cents—not even a whole penny! There is no question that the effect of time is substantial and dramatic.

The study of perpetuities in corporate finance is a first step to understanding valuation models of certain investments, such as the dividend discount model and the constant growth model, to be addressed in other chapters. Our ability to discount future cash flows, even infinite cash flows, to a present value is a clue to the price at which a company's stock might trade. From a personal financial planning perspective, the individual investor is also better able to be certain that they are paying a fair price for holdings in their portfolio. For purposes of long-term or retirement planning, the investor must consider that a fixed and unchanging dividend, such as from preferred stock, might not adequately protect the holder from inflation in times of rising prices.

## How to Value a Perpetuity

Given these facts, how do we place a value on a perpetuity? Let's keep the preferred stock example for Shaw Inc. in mind. The holder of one share will expect to receive a $2.00 dividend for every share owned. Although a perpetuity may allow for growth of that dividend, we will hold that constant now. We must know one additional fact: the required rate of return. This is our random variable, which can cause fluctuation in the price of the preferred stock. Let's assume that the required rate of return, which we'll call $R_S$, is 7%. This is the rate of return that the market expects in order to take on the risk of an investment such as Shaw.

Determination of the price of Shaw's preferred stock becomes quite simple because the expected annual cash flow should not change, making it a **constant perpetuity**. The constant perpetuity formula is

$$\text{PV} = \frac{C}{R_S} \tag{8.1}$$

where PV is the price of the preferred stock, $C$ is the constant dividend, and $R_S$ is the required rate of return.

By substitution,

$$\text{PV} = \frac{\$2.00}{0.07} = \$28.57 \tag{8.2}$$

The price one should pay for a share of Shaw's preferred stock is $28.57.

Here's another constant perpetuity to try. The preferred stock of Rooney Corporation pays an annual dividend of $1.75 per share. If the required rate of return in the market for shares such as Rooney's is 5.8%, at what price should these preferred shares be trading? The answer is $\frac{\$1.75}{0.058}$, or $30.17.

Some investments might involve a **growing perpetuity**. In this case, some degree of change in the amount of the dividend is expected. The formula is altered slightly to include a rate of growth in the denominator, noted as $G$, making the growing perpetuity formula

$$\text{PV} = \frac{C}{R_S - G} \tag{8.3}$$

To illustrate a growing perpetuity, let's revisit Rooney Corp.'s stock, with its annual dividend of $1.75 and a required rate of return in the market of 5.8%. If the expected dividend growth rate $G$ is 1.2%, then the value

changes to $\frac{\$1.75}{0.058 - 0.012}$, or $38.04. The expectation of growth in the dividend provides incentive for the investor to pay a higher price.

## THINK IT THROUGH

### A Growing Perpetuity

**Savo Corporation.** While we think of perpetuities as being static, with a constant benefit or dividend, as seen above, they might have the possibility of growth. Let's assume that our preferred stock in Savo Corporation is expected to grow at a rate of 0.2% per year. Its annual dividend per share is $4.00, and its required rate of return in the market is 3%. If this is a constant dividend stock, like most preferred stock, its price would be expected to approximate

$$\text{PV} = \frac{C}{R_s} \tag{8.4}$$

or

$$\frac{\$4.00}{0.03} = \$133.33 \tag{8.5}$$

When we factor in the 0.2% annual growth in the dividend, what does the price per share become?

**Solution:**

$$\text{PV} = \frac{4}{(0.03 - 0.002)} = \$142.86.86 \tag{8.6}$$

## THINK IT THROUGH

### College Endowment

In the case of an endowment for a college chair, as noted in the beginning of this section, instead of a dividend amount for a preferred stock, we would use the desired amount of the distribution that the chair would receive as part of their compensation package. Assume the college can invest this money at a fixed 3.5% annual rate. If you wish to gift the college enough funds to be held in perpetuity to produce $75,000 each year for that professor, how would you calculate this?

**Solution:**

We modify the constant perpetuity formula:

$$\text{Gift} = \frac{\text{Annual Distribution}}{R_s} \tag{8.7}$$

$$\text{Gift} = \frac{\$75{,}000}{0.035} = \$2{,}142{,}857 \tag{8.8}$$

In one year, $2,142,857 grows to

$$\$2{,}142{,}857 \times 1.035 = \$2{,}217{,}857 \tag{8.9}$$

The earnings (gift) of $75,000 are withdrawn to compensate the professor, and we are left with the amount originally endowed, $2,142,857:

$$\$2{,}217{,}857 - \$75{,}000 = \$2{,}142{,}857 \tag{8.10}$$

# 8.2 Annuities

## Learning Outcomes

By the end of this section, you will be able to:

- Define annuity.
- Distinguish between an ordinary annuity and an annuity due.
- Calculate the present value of an ordinary annuity and an annuity due.
- Explain how annuities may be used in lotteries and structured settlements.
- Explain how annuities might be used in retirement planning.

## Calculating the Present Value of an Annuity

An **annuity** is a stream of fixed periodic payments to be paid or received in the future. Present or future values of these streams of payments can be calculated by applying time value of money formulas to each of these payments. We'll begin with determining the present value.

Before exploring present value, it's helpful to analyze the behavior of a stream of payments over time. Assume that we commit to a program of investing $1,000 at the *end* of each year for five years, earning 7% compounded annually throughout. The high rate is locked in based partly on our commitment beginning today, even though we will invest no money until the end of the first year. Refer to the timeline shown in Table 8.1.

| Year | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Balance Forward ($) | 0.00 | 0.00 | 1,000.00 | 2,070.00 | 3,214.90 | 4,439.94 |
| Interest Earned ($) | | 0.00 | 70.00 | 144.90 | 225.04 | 310.80 |
| Principal Added ($) | | 1,000.00 | 1,000.00 | 1,000.00 | 1,000.00 | 1,000.00 |
| **New Balance ($)** | | **1,000.00** | **2,070.00** | **3,214.90** | **4,439.94** | **5,750.74** |

**Table 8.1**

At the end of the first year, we deposit the first $1,000 in our fund. Therefore, it has not yet had an opportunity to earn us any interest. The "new balance" number beneath is the cumulative amount in our fund, which then carries to the top of the column for the next year. In year 2, that first amount will earn 7% interest, and at the end of year 2, we add our second $1,000. Our cumulative balance is therefore $2,070, which then carries up to the top of year 3 and becomes the basis of the interest calculation for that year. At the end of the fifth year, our investing arrangement ends, and we've accumulated $5,750.74, of which $5,000 represents the money we invested and the other $750.74 represents accrued interest on both our invested funds and the accumulated interest from past periods.

Notice two important aspects that might appear counterintuitive: (1) we've "wasted" the first year because we deposited no funds at the beginning of this plan, and our first $1,000 begins working for us only at the beginning of the second year; and (2) our fifth and final investment earns no interest because it's deposited at the end of the last year. We will address these two issues from a practical application point of view shortly.

Keeping this illustration in mind, we will first focus on finding the present value of an annuity. Assume that you wish to receive $25,000 each year from an existing fund for five years, beginning one year from now. This stream of annual $25,000 payments represents an annuity. Because the first payment will be received one year from now, we specifically call this an **ordinary annuity**. We will look at an alternative to ordinary annuities later. How much money do we need in our fund today to accomplish this stream of payments if our remaining balance will always be earning 8% annually? Although we'll gradually deplete the fund as we withdraw periodic payments of the same amount, whatever funds remain in the account will always be earning interest.

Before we investigate a formula to calculate this amount, we can illustrate the objective: determining the present value of this future stream of payments, either manually or using Microsoft Excel. We can take each of the five payments of $25,000 and discount them to today's value using the simple present value formula:

$$\text{PV} = \frac{\text{FV}}{(1+r)^n} \tag{8.11}$$

where FV is the future value, PV is the present value, $r$ is the interest rate, and $n$ is the number of periods.

For example, the first $25,000 is discounted by the equation as follows:

$$\begin{aligned} \text{PV} &= \frac{\$25{,}000}{(1+0.08)^1} \\ \text{PV} &= \frac{\$25{,}000}{1.08} = \$23{,}148.15 \end{aligned} \tag{8.12}$$

Proof that $23,148.15 will grow to $25,000 in one year at 8% interest:

$$\$23{,}148.15 \times 1.08 = \$25{,}000 \tag{8.13}$$

If we use this same method for each of the five years, increasing the exponent $n$ for each year, we see the result in Table 8.2.

| Year | Calculation | Result |
|---|---|---|
| 1 | $\$25{,}000 \div (1.08)^1$ | $23,148.15 |
| 2 | $\$25{,}000 \div (1.08)^2$ | $21,433.47 |
| 3 | $\$25{,}000 \div (1.08)^3$ | $19,846.81 |
| 4 | $\$25{,}000 \div (1.08)^4$ | $18,375.75 |
| 5 | $\$25{,}000 \div (1.08)^5$ | $17,014.58 |
| **TOTAL** | | **$99,818.76** |

**Table 8.2 Present Value of Future Payments**

We begin with the amount calculated in our table, $99,818.76. Before any money is withdrawn, a year's worth of interest at 8% is compounded and added to our balance. Then our first $25,000 is withdrawn, leaving us with $82,804.26. This process continues until the end of five years, when, aside from a minor rounding difference, the fund has "done its job" and is equal to zero. However, we can make this simpler. Because each payment withdrawn (or added, as we will see later) is the same, we can calculate the present value of an annuity in one step using an equation. Rather than the multiple steps above, we will use the following equation:

$$\text{PVa} = \text{PYMT} \times \frac{\left[1 - \frac{1}{(1+r)^n}\right]}{r} \tag{8.14}$$

where PVa is the present value of the annuity and PYMT is the amount of one payment.

In this example, PYMT is $25,000 at the end of each of five years. Note that the greater the number of periods and/or the size of the amount borrowed, the greater the chances of large rounding errors. We have used six decimal places in our calculations, though the actual time value of money factor, combining interest and time, can be much longer. Therefore, our solutions will often use ≅ rather than the equal sign.

By substitution, and then following the proper order of operations:

$$\begin{aligned}
\text{PVa} &= \$25{,}000 \times \frac{\left[1 - \frac{1}{(1 + 0.08)^5}\right]}{0.08} \\
\text{PVa} &= \$25{,}000 \times \frac{\left(1 - \frac{1}{1.469328}\right)}{0.08} \\
\text{PVa} &= \$25{,}000 \times \frac{1 - 0.680583}{0.08} \\
\text{PVa} &= \$25{,}000 \times \frac{0.319417}{0.08} \\
\text{PVa} &= \$25{,}000 \times 3.9927125 \\
\text{PVa} &\approx \$99{,}817.81
\end{aligned} \tag{8.15}$$

In both cases, barring a rounding difference caused by decimal expansion, we come to the same result using the equation as when we calculate each of multiple years. It's important to note that rounding differences can become significant when dealing with larger multipliers, as in the financing of a multimillion-dollar machine or facility. In this text, we will ignore them.

In conclusion, five payments of $25,000, or $125,000 in total, can be funded today with $99,817.81, with the difference being obtained from interest always accumulating on the remaining balance at 8%. The running balance is obtained by calculating the year's interest on the previous balance, adding it to that balance, and subtracting the $25,000 that is withdrawn on the last day of the year. In the last (fifth) year, just enough interest will accrue to bring the balance to the $25,000 needed to complete the fifth payment.

A common use of the PVa is with large-money lotteries. Let's assume you win the North Dakota Lottery for $1.2 million, and they offer you $120,000 per year for 10 years, beginning one year from today. We will ignore taxes and other nonmathematical considerations throughout these discussions and problems. The Lottery Commission will likely contact you with an alternative: would you like to accept that stream of payments … or would you like to accept a **lump sum** of $787,000 right now instead? Can you complete a money-based analysis of these alternatives? Based purely on the dollars, no, you cannot. The reason is that you can't compare future amounts to present amounts without considering the effect of time—that is, the time value of money. Therefore, we need an interest rate that we can use as a discounting factor to place these alternatives on the same playing field by expressing them in terms of today's dollars, the present value. Let's use 9%. If we discount the future stream of fixed payments (an ordinary annuity, as the payments are identical and they begin one year from now), we can then compare that result to the cash lump sum that the Lottery Commission is offering you instead.

By substitution, and following the proper order of operations:

$$\begin{aligned}
\text{PVa} &= \$120{,}000 \times \frac{\left[1 - \frac{1}{(1 + 0.09)^{10}}\right]}{0.09} \\
\text{PVa} &= \$120{,}000 \times \frac{\left(1 - \frac{1}{2.3673637}\right)}{0.09} \\
\text{PVa} &= \$120{,}000 \times \frac{1 - 0.4224108}{0.09} \\
\text{PVa} &= \$120{,}000 \times \frac{0.5775892}{0.09} \\
\text{PVa} &= \$120{,}000 \times 6.4176578 \\
\text{PVa} &\approx \$770{,}119
\end{aligned} \tag{8.16}$$

All things being equal, that expected future stream of ten $120,000 payments is worth approximately $770,119 today. Now you can compare like numbers, and the $787,000 cash lump sum is worth more than the discounted future payments. That is the choice one would accept without considering such aspects as taxation, desire, need, confidence in receiving the future payments, or other variables.

## Calculating the Present Value of an Annuity Due

Earlier, we defined an ordinary annuity. A variation is the **annuity due**. The difference between the two is one period. That's all—just one additional period of interest. An ordinary annuity assumes that there is a one-period lag between the start of a stream of payments and the actual first payment. In contrast, an annuity due assumes that payments begin immediately, as in the lottery example above. We would assume that you would receive the first annual lottery check of $120,000 immediately, not a year from now. In summary, whether calculating future value (covered in the next section) or present value of an annuity due, the one-year lag is eliminated, and we begin immediately.

Since the difference is simply one additional period of time, we can adjust for this easily by taking the formula for an ordinary annuity and multiplying by one additional period. One more period, of course, is $(1 + i)$. Recall from Time Value of Money I that the formula for compounding is $(1 + i)^N$, where $i$ is the interest rate and $N$ is the number of periods. The superscript $N$ does not apply because it represents 1, for one additional period, and the power of 1 can be ignored. Therefore, faced with an annuity due problem, we solve as if it were an ordinary annuity, but we multiply by $(1 + i)$ one more time.

In our original example from this section, we wished to withdraw $25,000 each year for five years from a fund that we would establish now. We determined how much that fund should be worth today if we intend to receive our first payment one year from now. Throughout this fund's life, it will earn 8% annually. This time, let's assume we'll withdraw our first payment immediately, at point zero, making this an annuity due. Because we're trying to determine how much our starting balance should be, it makes sense that we must begin with a larger number. Why? Because we're pulling our first payment out immediately, so less money will remain to start compounding to the amount we need to fund all five of our planned payments! Our rule can be stated as follows:

Whether one is calculating present value or future value, the result of an annuity due must always be larger than that of an ordinary annuity, all other facts remaining constant. Here is the stream of solutions for the example above, but please notice that we will multiply by $(1 + i)$, one additional period, following the same order of operations:

$$
\begin{aligned}
\text{PVa} &= \$25{,}000 \times \frac{\left[1 - \frac{1}{(1 + 0.08)^5}\right]}{0.08} \times (1 + 0.08) \\
\text{PVa} &= \$25{,}000 \times \frac{\left(1 - \frac{1}{1.469328}\right)}{0.08} \times 1.08 \\
\text{PVa} &= \$25{,}000 \times \frac{1 - 0.680583}{0.08} \times 1.08 \\
\text{PVa} &= \$25{,}000 \times \frac{0.319417}{0.08} \times 1.08 \\
\text{PVa} &= \$25{,}000 \times 3.9927125 \times 1.08 \\
\text{PVa} &\approx \$107{,}803.24
\end{aligned}
\qquad \textbf{8.17}
$$

That's how much we must start our fund with today, before we earn any interest or draw out any money. Note that it's larger than the $99,817.81 that would be required for an ordinary annuity. It must be, because we're about to diminish our compounding power with an immediate withdrawal, so we have to begin with a larger amount.

We notice several things:

1. The formula must change because the annual payment is subtracted first, prior to the calculation of annual interest.
2. We accomplish the same result, aside from an insignificant rounding difference: the fund is depleted once the last payment is withdrawn.
3. The last payment is withdrawn on the first day of the final year, not the last. Therefore, no interest is

earned during the fifth and final year.

To reinforce this, let's use the same approach for our lottery example above. Reviewing the facts, you have a choice of receiving 10 annual payments of your $1.2 million winnings, each worth $120,000, and you discount at a rate of 9%. The only difference is that this time, you can receive your first $120,000 right away; you don't have to wait a year. This is now an annuity due. We solve it just as before, except that we multiply by one additional period of interest, $(1 + i)$:

$$\begin{aligned}
\text{PVa} &= \$120{,}000 \times \frac{\left[1 - \frac{1}{(1 + 0.09)^{10}}\right]}{0.09} \times 1.09 \\
\text{PVa} &= \$120{,}000 \times \frac{\left(1 - \frac{1}{2.3673637}\right)}{0.09} \times 1.09 \\
\text{PVa} &= \$120{,}000 \times \frac{1 - 0.4224108}{0.09} \times 1.09 \\
\text{PVa} &= \$120{,}000 \times \frac{0.5775892}{0.09} \times 1.09 \\
\text{PVa} &= \$120{,}000 \times 6.4176578 \times 1.09 \\
\text{PVa} &\approx \$839{,}429
\end{aligned} \tag{8.18}$$

Again, this result must be larger than the amount we determined when this was calculated as an ordinary annuity.

The calculations above, representing the present values of ordinary annuities and annuities due, have been presented on an annual basis. In Time Value of Money I, we saw that compounding and discounting calculations can be based on non-annual periods as well, such as quarterly or monthly compounding and discounting. This aspect, quite common in periodic payment calculations, will be explored in a later section of this chapter.

## Calculating Annuities Used in Structured Settlements

In addition to lottery payouts, annuity calculations are often used in **structured settlements** by attorneys at law. If you win a $450,000 settlement for an insurance claim, the opposing party may ask you to accept an annuity so that they can pay you in installments rather than a lump sum of cash. What would a fair cash distribution by year mean? If you have a preferred **discount rate** (the percentage we all must know to calculate the time value of money) of 6% and you expect equal distributions of $45,000 over 10 years, beginning one year from now, you can use the present value of an annuity formula to compare the alternatives:

$$\text{PVa} = \text{PYMT} \times \frac{\left[1 - \frac{1}{(1 + r)^n}\right]}{r} \tag{8.19}$$

By substitution:

$$\begin{aligned}
\text{PVa} &= \$45{,}000 \times \frac{\left[1 - \frac{1}{(1 + 0.06)^{10}}\right]}{0.06} \\
\text{PVa} &= \$45{,}000 \times \frac{\left(1 - \frac{1}{1.790848}\right)}{0.06} \\
\text{PVa} &= \$45{,}000 \times \frac{0.4416053}{0.06} \\
\text{PVa} &= \$45{,}000 \times 7.360089 \\
\text{PVa} &\approx \$331{,}204
\end{aligned} \tag{8.20}$$

If the opposing attorney offered you a lump sum of cash less than that, all things equal, you would refuse it; if the lump sum were greater than that, you would likely accept it.

What if you negotiate the first payment to be made to you immediately, turning this ordinary annuity into an annuity due? As noted above, we simply multiply by one additional period of interest, (1 + 0.06). Repeating the last step of the solution above and then multiplying by (1 + 0.06), we determine that

$$\begin{aligned} \text{PVa} &= \$45{,}000 \times 7.360089 \times 1.06 \\ \text{PVa} &\approx \$351{,}076 \end{aligned} \quad \textbf{8.21}$$

You would insist on that number as an absolute minimum before you would consider accepting the offered stream of payments.

To further verify that ordinary annuity can be converted into an annuity due by multiplying the solution by one additional period's worth of interest before applying the annuity factor to the payment, we can divide the difference between the two results by the value of the original annuity. When the result is expressed as a percent, it must be the same as the rate of interest used in the annuity calculations. Using our example of an annuity with five payments of $25,000 at 8%, we compare the present values of the ordinary annuity of $99,817.81 and the annuity due of $107,803.24.

$$\frac{\$107{,}803.24 - \$99{,}817.81}{\$99{,}817.81} = 0.08 = 8\% \quad \textbf{8.22}$$

The result shows that the present value of the annuity due is 8% higher than the present value of the ordinary annuity.

## Calculating the Future Value of an Annuity

In the previous section, we addressed discounting a periodic stream of payments from the future to the present. We are also interested in how to project the future value of a series of payments. In this case, an investment may be made periodically. Keeping with the definition of an annuity, if the amount of periodic investment is always the same, we may take a one-step shortcut to calculate the future value of that stream by using the formula presented below:

$$\text{FVa} = \text{PYMT} \times \frac{(1+r)^N - 1}{r} \quad \textbf{8.23}$$

where FVa is the future value of the annuity, PYMT is a one-time payment or receipt in the series, $r$ is the interest rate, and $n$ is the number of periods.

As we did in our section on present values of annuities, we will begin with an ordinary annuity and then proceed to an annuity due.

Let's assume that you lock in a contract for an investment opportunity at 4% per year, but you cannot make the first investment until one year from now. This is counterintuitive for an investor, perhaps, but because it is the basis of the formula and procedures for ordinary annuities, we will accept this assumption. You plan to invest $3,000 at the end of each year. How much money will you have at the end of five years?

Let's start by placing this on a timeline like the one appearing earlier in this chapter (see Table 8.3):

| Year | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Balance Forward ($) | 0.00 | 0.00 | 3,000.00 | 6,120.00 | 9,364.80 | 12,739.39 |
| Interest Earned ($) | | 0.00 | 120.00 | 244.80 | 374.59 | 509.58 |
| Principal Added ($) | | 3,000.00 | 3,000.00 | 3,000.00 | 3,000.00 | 3,000.00 |
| **New Balance ($)** | | **3,000.00** | **6,120.00** | **9,364.80** | **12,739.39** | **16,248.97** |

**Table 8.3**

As we explained earlier when describing ordinary annuities, the payment for year 1 is not invested until the last day of that year, so year 1 is wasted as a compounding opportunity. Therefore, the amount only compounds for four years rather than five. Also, our fifth payment is not made until the last day of our contract in year 5, so it has no chance to earn a compounded future value. The investor has lost on both ends. In the table above, we have made five calculations, and for a longer-term contract such as 10, 25, or 40 years, this would be tedious. Fortunately, as with present values, this ordinary annuity can be solved in one step because all payments are identical.

Repeating the formula, and then by substitution:

$$\begin{aligned} \text{FVa} &= \text{PYMT} \times \frac{(1+r)^N - 1}{r} \\ \text{FVa} &= \$3{,}000 \times \frac{(1+0.04)^5 - 1}{0.04} \\ \text{FVa} &= \$3{,}000 \times \frac{1.216653 - 1}{0.04} \\ \text{FVa} &= \$3{,}000 \times 5.416325 \\ \text{FVa} &= \$16{,}248.98 \end{aligned} \tag{8.24}$$

This proof emphasizes that year 1 is wasted, with no compounding because the payment is made on the last day of year 1 rather than immediately. We lose compounding through this ordinary annuity in another way: year 5's investment is made on the last day of this five-year contract and has no chance to accumulate interest. A more intuitive method would be to enter a contract for an annuity due so that our first payment can be made immediately. In this way, we don't waste the first year, and all five payments work in year 5 as well. As stated previously, this means that annuities due will yield larger results than ordinary annuities, whether one is discounting (PVa) or compounding (FVa).

Let's hold all facts constant with the previous example, except that we will invest at the beginning of each year, starting immediately upon locking in this five-year contract. We follow the same technique as in the present value section: we multiply by one additional period to convert this ordinary annuity factor into a factor for an annuity due. Whether one is solving for a future value or a present value, the result of an annuity due must always be larger than an ordinary annuity. With future value, we begin investing immediately, so the result will be larger than if we waited for a period to elapse. With present value, we begin extracting funds immediately rather than letting them work for us during the first year, so logically we would have to start with more.

Continuing our example but converting it to an annuity due, we will multiply by one additional period, $(1 + i)$. All else remains the same:

$$\begin{aligned} \text{FVa} &= \$3{,}000 \times \frac{(1+0.04)^5 - 1}{0.04} \times 1.04 \\ \text{FVa} &= \$3{,}000 \times \frac{1.216653 - 1}{0.04} \times 1.04 \\ \text{FVa} &= \$3{,}000 \times 5.416325 \times 1.04 \\ \text{FVa} &\approx \$16{,}898.93 \end{aligned} \tag{8.25}$$

Let's provide one additional example of each. Assume that you have a chance to invest $15,000 per year for 10 years, earning 8% compounded annually. What amount would you have after the 10 years? If we can only make our first payment at the end of each year, our ending value will be

$$\begin{aligned} \text{FVa} &= \$15{,}000 \times \frac{(1+0.08)^{10} - 1}{0.08} \\ \text{FVa} &= \$15{,}000 \times \frac{2.158925 - 1}{0.08} \\ \text{FVa} &= \$15{,}000 \times 14.486563 \\ \text{FVa} &\approx \$217{,}298 \end{aligned} \tag{8.26}$$

However, if we can make our first payment immediately and then make subsequent payments at the start of

each following year, we modify the formula above by multiplying the annual payment by one additional period:

$$\begin{aligned} \text{FVa} &= \$15{,}000 \times 14.486563 \times 1.08 \\ \text{FVa} &\approx \$234{,}682 \end{aligned} \quad \textbf{8.27}$$

THINK IT THROUGH

### Begin an Investing Program at Age 20 or 30?

In this chapter's introductory section, Why It Matters, we posed a question about pledging to invest $1,000 each year until you reach age 60. If you can earn a 5% annual rate of interest, how much will you have if you begin at age 20? What if you delay this program until age 30? The additional 10 years can make a surprisingly large difference. How can you calculate that difference?

**Solution:**

Perform two separate calculations comparable to the chapter examples above, using the formula for the future value of an ordinary annuity. You plan to make the first investment immediately, making this an annuity due, so you will multiply by one additional period, (1 + 0.05). Notice that the only difference between the two calculations is the exponent *N*, representing the number of periods.

Thirty years (starting at age 30):

$$\begin{aligned} \text{FVa} &= \$1{,}000 \times \frac{(1+0.05)^{30}-1}{0.05} \times 1.05 \\ \text{FVa} &= \$1{,}000 \times 66.438848 \times 1.05 \\ \text{FVa} &\approx \$69{,}761 \end{aligned} \quad \textbf{8.28}$$

Forty years (starting at age 20):

$$\begin{aligned} \text{FVa} &= \$1{,}000 \times \frac{(1+0.05)^{40}-1}{0.05} \times 1.05 \\ \text{FVa} &= \$1{,}000 \times 120.799774 \times 1.05 \\ \text{FVa} &\approx \$126{,}840 \end{aligned} \quad \textbf{8.29}$$

Waiting 10 years before committing to this program comes with a surprisingly high cost—a loss of almost 82% of the potential value.

## How Annuities Are Used for Retirement Planning

On a final note, how might annuities be used for **retirement planning**? A person might receive a lump-sum windfall from an investment, and rather than choosing to accept the proceeds, they might decide to invest the sum (ignoring taxes) in an annuity. Their intention is to let this invested sum produce annual distributions to supplement Social Security payments. Assume the recipient just received $75,000, again ignoring tax effects. They have the chance to invest in an annuity that will provide a distribution at the end of each of the next five years, and that annuity contract provides interest at 3% annually. Their first receipt will be one year from now. This is an ordinary annuity.

We can also solve for the payment given the other variables, an important aspect of financial analysis. If the person with the $75,000 windfall wants this fund to last five years and they can earn 3%, then how much can they withdraw from this fund each year? To solve this question, we can apply the present value of an annuity formula. This time, the payment (PYMT) is the unknown, and we know that the PVa, or the present value that they have at this moment, is $75,000:

$$\begin{aligned}
\text{PVa} &= \text{PYMT} \times \frac{\left[1 - \frac{1}{(1+r)^n}\right]}{r} \\
\$75{,}000 &= \text{PYMT} \times \frac{\left[1 - \frac{1}{(1+0.03)^5}\right]}{0.03} \\
\$75{,}000 &= \text{PYMT} \times \frac{\left(1 - \frac{1}{1.159274}\right)}{0.03} \\
\$75{,}000 &= \text{PYMT} \times 4.579705 \\
\text{PYMT} &= \$75{,}000 \div 4.579705 \\
\text{PYMT} &\approx \$16{,}376.60
\end{aligned} \qquad \textbf{8.30}$$

The person can withdraw this amount every year beginning one year from now, and when the final payment is withdrawn, the fund will be depleted. Interest accrues each year on the beginning balance, and then $16,376.60 is withdrawn at the end of each year.

LINK TO LEARNING

Another View of Annuities

Many examples of annuities are available, with presentations as varied as the opinions as to how appropriate they are for investors, especially retirees. Math Is Fun (https://openstax.org/r/Math_Is_Fun) is particularly interesting and potentially helpful for understanding how to apply this knowledge.

# 8.3 Loan Amortization

## Learning Outcomes

By the end of this section, you will be able to:

- Distinguish between different types of loans.
- Explain how amortization works.
- Create an amortization schedule.
- Calculate the cost of borrowing.

## Types of Loans

Funds can be loaned to businesses of any type, including corporations, partnerships, limited liability companies, and proprietorships. Bankers often refer to these lending structures as *facilities*, and they can be tailored to the specific needs of the borrower in a number of ways. Similarly, lenders develop loans and lines of credit for individuals. Whether for a business or an individual, the purpose of the loan, method of repayment, interest rate, specific terms, and time involved must all be tailored to the goals of the borrower and the lender. In this chapter, we will focus on fixed-rate loans, although other alternatives exist.

Typical business loans include the following:

- Term loans generally bear a maturity date and a set rate of interest and are typically used to finance investments in assets such as equipment, buildings, and possibly other acquired firms. The length of the term loan is generally designed to match the useful life of the asset being financed, and it will usually be repaid on a monthly schedule. It's common for a term loan to be backed by collateral, such as the asset itself or other assets of the business.
- Revolving lines of credit (revolvers), are used to finance the short-term working capital needs of a business. Revolvers will have a specific maximum but no set schedule of monthly payments. Interest accrues on the amount of cash that a company has drawn down from the facility. These credit lines may be

secured by accounts receivable, inventory, other assets of the business, or sometimes simply the good faith and credit of the company if the firm is strong, creditworthy, and established with the lender. Revolvers must often be fully repaid and unused for a short period of time to assure the lender that the borrower is not using this facility for longer-term needs.

Personal loans also come in several types, designed for the purpose the borrower (consumer) has in mind, with assistance from the lender in determining the appropriate structure:

- Personal lines of credit are similar to lines of credit on bank cards, with interest being charged on the outstanding balance of the credit line. These are available on the basis of personal credit scores, with data being supplied by the three best-known credit reporting firms: Experian, Equifax, and TransUnion. Individuals should check their scores with each of these companies at least once per year, which they can do for no charge. Additional requests from the same company require a small fee.
- An unsecured personal loan is an installment loan, initially drawn for a fixed amount and repaid on a periodic schedule with interest, as we have seen in our annuity examples. Unsecured means that the loan is not secured by collateral but is instead based on the strong credit history of the borrower.
- In contrast, a secured personal loan has an asset backing up the unpaid amount, and if the consumer defaults on the debt, the asset can be seized by the lender to satisfy their claim. A common example is an auto loan, which is secured by the car being purchased; nonpayment or default on the loan can lead to the borrower's car being repossessed.
- A mortgage loan is another type of secured personal loan, but for a longer period, such as 20, 25, or even 30 years. The home being purchased or built is the collateral, and the home may be foreclosed upon if the borrower defaults. Full title to the home typically remains with the lender as long as an unpaid balance remains on the debt.
- Student loans are borrowings intended to fund college or career education, and they can come from a financial institution or the federal government. Interest rates on these loans are generally low and advantageous, and repayment does not begin until after the borrower's education is complete (or if they drop below a certain level of time status, such as becoming a half-time student).

## Calculating Loan Payments Using Simple Amortization

**Loan amortization** refers to a schedule of how and when a debt will be repaid with interest. As noted, we will focus on fixed-rate debts, such as auto loans, personal loans with installment payments, or mortgages. Before entering into a borrowing agreement, the borrower can use any of a number of tools to verify the terms being offered, such as the monthly payment on a car loan financed by the dealer. In many cases, this is accomplished by using the present value of an annuity formula:

$$\text{PVa} = \text{PYMT} \times \frac{\left[1 - \frac{1}{(1+r)^n}\right]}{r} \quad \textbf{8.31}$$

We've already reviewed the present value of ordinary annuities in several examples. Before we look into business or consumer loans and their repayment, we must review an area of Time Value of Money I.

We're not likely to make annual payments on a home mortgage or auto loan, as these are commonly paid on a monthly basis. Fortunately, our formulas are easily adjusted from annual to non-annual periods. You will recall that we solve for non-annual periods in the same way, with two adjustments: (1) we divide the annual interest rate by the number of periods in the year, and (2) we multiply the time periods by the number of those periods within a year. Therefore, in the case of monthly debt service, including interest and principal, we use 12 periods.

Given a three-year car loan at 6%, rather than using 6% and 3 periods in our formula, we would instead use 0.5% (6% ÷ 12) and 36 periods (3 years × 12), and then apply the present value of an annuity formula in the same way. Let's say the three-year, 6% auto loan is for $32,000. You need to know if you can squeeze the monthly payment into your budget. For our examples, we will ignore any other charges, fees, taxes, or extras

that your lender might include in these payments, and we will focus only on interest and principal repayment. You will make the first payment one month from now, making this an ordinary annuity. What is the amount of your monthly debt service? In this case, you would be solving for a different unknown: the payment amount.

By substitution into the present value of an annuity formula, adjusting for monthly payments as noted:

$$\begin{aligned} \$32{,}000 &= \text{PYMT} \times \frac{\left[1 - \frac{1}{(1 + 0.005)^{36}}\right]}{0.005} \\ \$32{,}000 &= \text{PYMT} \times \frac{\left(1 - \frac{1}{1.196681}\right)}{0.005} \\ \$32{,}000 &= \text{PYMT} \times \frac{1 - 0.835645}{0.005} \\ \$32{,}000 &= \text{PYMT} \times \frac{0.164355}{0.005} \\ \$32{,}000 &= \text{PYMT} \times 32.871 \end{aligned} \tag{8.32}$$

Dividing both sides by 32.781 to isolate the payment amount (PYMT) gives us

$$\begin{aligned} \text{PYMT} &= \frac{\$32{,}000}{32.871} \\ \text{PYMT} &\approx \$973.50 \end{aligned} \tag{8.33}$$

Solving for the payment, we find that it's approximately $973.50 per month. You consult your monthly budget and find that you can cover this monthly payment, so you conclude the deal. Ask the salesperson for the amortization table on this debt to show how your 36 payments of $973.50 will cover your interest plus repayment of the principal amount of the debt. At this point, you know how to complete your own table. Using a financial calculator or Microsoft Excel simplifies the operation above to a few keystrokes, as presented later in this chapter.

Two extracts from an amortization table are shown in Table 8.4.

| Month | Payment | Interest | Principal | Remaining Balance |
|---|---|---|---|---|
| 1 | 973.50 | 160.00 | 813.50 | 31,186.50 |
| 2 | 973.50 | 155.93 | 817.57 | 30,368.93 |
| 3 | 973.50 | 151.84 | 821.66 | 29,547.27 |
| 4 | 973.50 | 147.74 | 825.77 | 28,721.51 |
| 5 | 973.50 | 143.61 | 829.89 | 27,891.61 |
| *...continued...* | | | | |
| 33 | 973.50 | 19.23 | 954.27 | 2,891.54 |
| 34 | 973.50 | 14.46 | 959.04 | 1,932.50 |
| 35 | 973.50 | 9.66 | 963.84 | 968.66 |
| 36 | 973.50 | 4.84 | 968.66 | 0.00 |
| **Total** | **35,046.00** | **3,046.08** | **32,000.00** | |

**Table 8.4 Extracts from an Amortization Table ($)**

This table resembles proofs we have seen of annuities, but let's focus on some details:

1. Each fixed payment contains both interest and principal repayment.
2. Because the payments are fixed and the amount of remaining debt is decreasing, the monthly interest portion is always decreasing, and the amount of principal payment therefore must be increasing.

We can conclude that the lender is making more of their revenue (interest) in the early months than in the

later months. In addition, the debt is decreasing slowly in the early months and more rapidly in the later months. We can all agree that lenders are compensated for the risks they take earlier rather than later. Of the 36 payments of $973.50, $32,000 has been repaid as the principal borrowed. The remaining $3,046.08 is the lender's revenue, the cost of credit.

For an additional example, one that drives home the point that more interest is paid in the early months of a long-term loan, we will consider a 20-year home mortgage. Home mortgage payments are typically made monthly, and again, we will ignore additional charges by the lender, such as real estate tax and homeowner's insurance. Let's assume you buy a $200,000 home, pay $60,000 as a cash deposit, and will finance the remaining $140,000 over 20 years. The bank offers you a 3.6% annual interest rate. What will the amount of your monthly payment be for the interest and principal repayment? The bank will tell you, of course, but let's prove it for ourselves. We'll do it in exactly the same fashion as the car loan above, using the present value of an annuity formula. Remember that you are not financing the entire $200,000 purchase; you pay $60,000 in cash, so you are only financing the remaining $140,000.

We modify the periods from years to months by multiplying by 12, and we modify the annual rate to a monthly rate by dividing by 12, resulting in

$$\begin{aligned} n &= 240 \text{ months} \\ r &= 0.3\% \end{aligned} \tag{8.34}$$

By substitution into the present value of an annuity formula:

$$\begin{aligned} \$140{,}000 &= \text{PYMT} \times \frac{\left[1 - \frac{1}{(1 + 0.003)^{240}}\right]}{0.003} \\ \$140{,}000 &= \text{PYMT} \times \frac{\left(1 - \frac{1}{2.052220}\right)}{0.003} \\ \$140{,}000 &= \text{PYMT} \times \frac{1 - 0.487277}{0.003} \\ \$140{,}000 &= \text{PYMT} \times \frac{0.512723}{0.003} \\ \$140{,}000 &= \text{PYMT} \times 170.907667 \end{aligned} \tag{8.35}$$

We divide both sides by 170.907667 to isolate the payment amount (PYMT):

$$\begin{aligned} \text{PYMT} &= \frac{\$140{,}000}{170.907667} \\ \text{PYMT} &\approx \$819.16 \end{aligned} \tag{8.36}$$

Your monthly mortgage payment is $819.16. As in our auto loan example, we'll complete an amortization table of our own—though, of course, you'll remember to ask your lender for their version. Extracts from a full 240-month table are shown in Table 8.5 below. The front-end packing of interest revenue is more obvious here because of the longer time period.

| Month | Payment | Interest | Principal | Remaining Balance |
|---|---|---|---|---|
| | | | | 140,000.00 |
| 1 | 819.16 | 420.00 | 399.16 | 139,600.84 |
| 2 | 819.16 | 418.80 | 400.36 | 139,200.48 |
| 3 | 819.16 | 417.60 | 401.56 | 138,798.92 |
| 4 | 819.16 | 416.40 | 402.76 | 138,396.16 |
| 5 | 819.16 | 415.19 | 403.97 | 137,992.19 |
| 6 | 819.16 | 413.98 | 405.18 | 137,587.01 |

**Table 8.5 Amortization Table for a Mortgage ($)**

| Month | Payment | Interest | Principal | Remaining Balance |
|---|---|---|---|---|
| 7 | 819.16 | 412.76 | 406.40 | 137,180.61 |
| 8 | 819.16 | 411.54 | 407.62 | 136,772.99 |
| 9 | 819.16 | 410.32 | 408.84 | 136,364.15 |
| *...continued....* | | | | |
| 236 | 819.16 | 12.17 | 806.99 | 3,250.84 |
| 237 | 819.16 | 9.75 | 809.41 | 2,441.44 |
| 238 | 819.16 | 7.32 | 811.84 | 1,629.60 |
| 239 | 819.16 | 4.89 | 814.27 | 815.33 |
| 240 | 819.16 | 2.45 | 816.71 | (1.38) |
| **Total** | **196,598.40** | **56,597.02** | **140,001.38** | **(Rounding)** |

**Table 8.5 Amortization Table for a Mortgage ($)**

As with your car loan, earlier payments contain more interest than loan repayment, so the lender's revenue is at a significant peak in the early years. The length of the loan, coupled with the frequent compounding, emphasizes this. In month 10, the interest and principal amounts "pass" each other, and now the loan balance is dropping at a quicker rate. Finally, note that you will pay more than $56,000 to finance this $140,000 borrowing. If you pay off this mortgage over 240 months as planned, the interest cost represents an additional 28% of the full cost of the home!

If the borrower has the means to make an accelerated payment against this debt—for example, due to a bonus or other windfall—doing so can make a significant difference in the total cost of financing over the life of the loan. Assume that after three years (month 36), you receive a bonus of $2,000 and decide to apply the entire amount to prepay the remaining balance. Your loan agreement allows you to apply the entire amount to the remaining unpaid balance of the mortgage. While this might seem equal to just 2.5 months' worth of payment, the debt is fully paid off almost 6 months ahead of schedule, and total interest is reduced from over $56,000 to $55,000. The ability to prepay long-term debts such as this is clearly worth negotiating initially.

# 8.4 Stated versus Effective Rates

## Learning Outcomes

By the end of this section, you will be able to:

- Explain the difference between stated and effective rates.
- Calculate the true cost of borrowing.

## The Difference between Stated and Effective Rates

If you look at the bottom of your monthly credit card statement, you could see language such as "The interest rate on unpaid balances is 1.5% per month." You might think to yourself, "So, that's 12 months times 1.5%, or 18% per year." This is a fine example of the difference between *stated* and *effective* annual interest rates. The **effective interest rate** reflects compounding within a one-year period, an important distinction because we tend to focus on annual interest rates. Because compounding occurs more than once per year, the true annual rate is higher than appears. Please remember that if interest is calculated and compounded annually, the stated and effective interest rates will be the same. Keep in mind that the following principles work whether you are the debtor paying off an obligation or an investor hoping for more frequent compounding. The dynamics of the time value of money apply in either direction.

## Effective Rates and Period of Compounding

Let's remain with our example of a credit card statement that indicates an interest rate of 1.5% per month on unpaid balances. If you use this card only once, to make a $1,000 purchase in January, and then fail to pay the bill when it comes due, the issuer will bill you $15. Now you owe them $1,015. Assume you completely ignore this bill and never pay it throughout the rest of the year. The monthly calculation of interest starts to compound on past interest assessments in addition to the $1,000 initial purchase (see Table 8.6).

| Month | Interest | Balance |
|---|---|---|
| | | 1,000.00 |
| 1 | 15.00 | 1,015.00 |
| 2 | 15.23 | 1,030.23 |
| 3 | 15.45 | 1,045.69 |
| 4 | 15.69 | 1,061.36 |
| 5 | 15.92 | 1.077.28 |
| 6 | 16.16 | 1,093.44 |
| 7 | 16.40 | 1,109.84 |
| 8 | 16.65 | 1,126.49 |
| 9 | 16.90 | 1,143.39 |
| 10 | 17.15 | 1,160.54 |
| 11 | 17.41 | 1,177.95 |
| 12 | 17.67 | 1,195.62 |

**Table 8.6 Compounded Interest on a Credit Card Statement ($)**

Because interest compounds monthly rather than annually, the effective annual rate is 19.56%, not the intuitive rate of the stated 1.5% times 12 months, or 18%. Our basic compounding formula of *(1+i)^n* by substitution shows:

$$(1 + 0.015)^{12} = 1.19562 \quad \textbf{8.37}$$

To isolate the effective annual rate, we then deduct 1 because our interest calculations are based on the value of $1:

$$(1 + 0.015)^{12} - 1 = 1.19562 - 1 = 0.19562 = 19.562\% \quad \textbf{8.38}$$

Therefore, it falls to the consumer/borrower to understand the true cost of borrowing, especially when larger dollar amounts are involved. If we had been dealing with $10,000 rather than $1,000, the annual difference would be more than $156.

### LINK TO LEARNING

#### A Helpful Demonstration . . .

From the Corporate Finance Institute (https://openstax.org/r/Corporate_Finance_Institute) comes a fine visual of a similar example. Here, we see the effective annual rate that results from taking a nominal annual rate of 12%, with a benefit to an investor if they have the benefit of monthly compounding.

One example of the importance of understanding effective interest rates is an invention from the early 1990s: the payday advance loan (PAL). The practice of offering such loans can be controversial because it can lead to very high rates of interest, perhaps even illegally high, in an act known as usury. Although some states have outlawed PALs and others place limits on them, some do not. A PAL is a short-term loan in anticipation of a person's next paycheck. A person in need of money for short-term needs will write a check on Thursday but date the check *next* Thursday, which is their normal payday; assume this transaction is for $200. The lender, typically operating from a storefront, will advance the $200 cash and hold the postdated check. The lender charges a fee—let's say $14—as their compensation. The following Thursday, the borrower is expected to pay off the advance, and if they do not, the lender can deposit the postdated check. If that check has insufficient funds, more fees and penalties will likely be assessed.

One primary reason that arrangements such as these are controversial is the excessively high nominal (stated) interest rate that they can represent. For a one-week loan of $200, the borrower is paying $14, or 7% of the borrowed amount. If this is annualized, with 52 seven-day periods in a year, the stated rate is 364%! While a PAL might seem to be an effective immediate solution to a cash shortfall, the mathematics behind the true cost of borrowing simply do not make sense, and a person who uses such arrangements regularly is placing themselves at a dreadful financial disadvantage.

## THINK IT THROUGH

### How Tempting Is That Refund Anticipation?

Refund anticipation loans (RALs) began in 1987, and they are still available (though not from banks) and used by millions of people.[1] Now, RALs come from private lending chains. These loans allow you to determine your April 15 personal income tax liability through a preparer and receive an advance against your expected refund.[2] But beware: your ability to analyze the true cost of money is always critical. Like all loans, RALs bear a rate of interest. Let's assume that the firm that prepared your tax return determines that you're entitled to an $800 refund. Once they advance that amount to you, it will bear interest at a certain rate; we'll assume 0.5% per week. You might expect a tax refund in four weeks. Half a percent of $800 doesn't sound like much, but what happens when you annualize it into an effective rate, assuming your tax refund arrives exactly four weeks from when you accept the loan? Assume no compounding during those four weeks.

**Solution:**

A weekly rate of 0.5% on the $800 advance is $4 per week, so for four full weeks, you've paid $16 for the use of $800. Of course, that totals 2% of the amount advanced. There are 13 four-week periods in a year, so even though the interest rate appears to be small, it amounts to 26% when annualized! We assumed no compounding to keep the illustration simple, but we further assume that you are not using this advance throughout the year. If you were, then periodic compounding would drive the effective rate even higher, to just over 29.3%.

1 Michelle Singletary. "Another Reason Not to Opt for a Tax Refund Loan: It May Delay Your Next Stimulus Payment." *Washington Post*, February 16, 2021. https://www.washingtonpost.com/business/2021/02/16/tax-refund-loan-problems/
2 Amelia Josephson. "What Is a Refund Anticipation Loan?" SmartAsset. March 18, 2021. https://smartasset.com/taxes/what-is-a-refund-anticipation-loan

# 8.5 Equal Payments with a Financial Calculator and Excel

## Learning Outcomes

By the end of this section, you will be able to:

- Use a financial calculator and Excel to solve perpetuity problems.
- Use a financial calculator and Excel to solve annuity problems.
- Calculate an effective rate of interest.
- Schedule the amortization of a loan repayment.

## Solving Time Value of Money Problems Using a Financial Calculator

Since the 1980s, many convenient and inexpensive tools have become available to simplify business and personal calculations, including personal computers with financial applications and handheld/desktop or online calculators with many of the functions we've studied already. This section will explore examples of both, beginning with financial calculators. While understanding and mastery of the use of time value of money equations are part of a solid foundation in the study of business and personal finance, calculators are rapid and efficient.

We'll begin with the constant perpetuity that we used to illustrate the constant perpetuity formula. A share of preferred stock of Shaw Inc., pays an annual $2.00 dividend, and the required rate of return that investors in this stock expect is 7%. The simple technique to solve this problem using the calculator is shown in Table 8.7.

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 1 | Set all variables to defaults | 2ND [RESET] ENTER | RST | 0.00 |
| 2 | Enter formula | 2 ÷ 7 % = | | 28.57 |

**Table 8.7 Calculator Steps to Find the Required Rate of Return**[3]

Earlier we solved for the present value of a 5-year ordinary annuity of $25,000 earning 8% annually. We then solved for an annuity due, all other facts remaining the same. The two solutions were $99,817.50 and $107,802.50, respectively. We enter our variables as shown in Table 8.8 to solve for an ordinary annuity:

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 1 | Set all variables to defaults | 2ND [RESET] ENTER | RST | 0.00 |
| 2 | Enter number of payments | 5 N | N = | 5.00 |
| 3 | Enter interest rate per payment period | 8 I/Y | I/Y = | 8.00 |
| 4 | Enter payment amount | 25000 +/− PMT | PMT = | -25,000.00 |
| 5 | Compute present value | CPT PV | PV = | 99,817.75 |

**Table 8.8 Calculator Steps to Solve for an Ordinary Annuity**

Note that the default setting on the financial calculator is END to indicate that payment is made at the end of a period, as in our ordinary annuity. In addition, we follow the payment amount of $25,000 with the +/- keystroke—an optional step to see the final present value result as a positive value.

To perform the same calculation as an annuity due, we can perform the same procedures as above, but with two additional steps after Step 1 to change the default from payments at the end of each period to payments at the beginning of each period (see Table 8.9).

3 The specific financial calculator in these examples is the Texas Instruments BA II Plus™ Professional model, but you can use other financial calculators for these types of calculations.

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 1 | Set all variables to defaults | 2ND [RESET] ENTER | RST | 0.00 |
| 2 | Change default to payment at end of period | 2ND [BGN] 2ND [SET] | BGN | 0.00 |
| 3 | Return to calculator mode | 2ND [QUIT] | | 0.00 |
| 4 | Enter number of payments | 5 N | N = | 5.00 |
| 5 | Enter interest rate per payment period | 8 I/Y | I/Y = | 8.00 |
| 6 | Enter payment amount | 25000 +/− PMT | PMT = | -25,000.00 |
| 7 | Compute present value | CPT PV | PV = | 107,803.17 |

**Table 8.9 Calculator Steps to Solve for an Annuity Due**

The procedures to find future values of both ordinary annuities and annuities due are comparable to the two procedures above. We begin with the ordinary annuity, with reminders that this is the default for the financial calculator and that entering the payment as a negative number produces a positive result (see Table 8.10).

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 1 | Set all variables to defaults | 2ND [RESET] ENTER | RST | 0.00 |
| 2 | Enter number of payments | 5 N | N = | 5.00 |
| 3 | Enter interest rate per payment period | 4 I/Y | I/Y = | 4.00 |
| 4 | Enter payment amount | 3000 +/− PMT | PMT = | -3,000.00 |
| 5 | Compute future value | CPT FV | FV = | 16,248.97 |

**Table 8.10 Calculator Steps to Find the Future Value of an Ordinary Annuity**

Solving for an annuity due with the same details requires the keystrokes listed in Table 8.11.

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 1 | Set all variables to defaults | 2ND [RESET] ENTER | RST | 0.00 |
| 2 | Change default to payment at end of period | 2ND [BGN] 2ND [SET] | BGN | 0.00 |
| 3 | Return to calculator mode | 2ND [QUIT] | | 0.00 |
| 4 | Enter number of payments | 5 N | N = | 5.00 |
| 5 | Enter interest rate per payment period | 4 I/Y | I/Y = | 4.00 |
| 6 | Enter payment amount | 3000 +/− PMT | PMT = | -3,000.00 |
| 7 | Compute future value | CPT FV | FV = | 16,898.93 |

**Table 8.11 Calculator Steps to Find the Future Value of an Annuity Due**

Earlier in the chapter, we explored the effect of interannual compounding on the true cost of money, recalling the basic compounding formula:

$$(1+i)^N \tag{8.39}$$

We saw that when modified for monthly compounding at a stated rate of 1.5%, the actual (effective) rate of interest per year was 19.56%. One simple way to prove this is by using the calculator keystrokes listed in Table 8.12.

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 1 | Set all variables to defaults | 2ND [RESET] ENTER | RST | 0.00 |
| 2 | Set the display to four decimal places | 2ND [FORMAT] 4 ENTER | DEC = | 4.0000 |
| 3 | Return to calculator mode | 2ND [QUIT] | | 0.0000 |
| 4 | Enter (1 + the monthly interest rate) | 1.015 $y^x$ | | 1.0150 |
| 5 | Enter the number of months | 12 $y^x$ | | 1.1956 |

**Table 8.12 Calculator Steps to Prove the Actual Rate of Interest per Year**

Had we assumed that the stated monthly interest rate of 1.5% could be simply multiplied by 12 months for an annual rate of 18%, we would be ignoring the effect of more frequent compounding. As indicated above, the annual interest on the money that we spent initially, accumulating at a rate of 1.5% *per month*, is 19.56%, not 18%:

$$1.1956 - \$1 \text{ spent intially} = 0.1956 = 19.56\% \quad \textbf{8.40}$$

The final example in this chapter will represent the amortization of a loan. Using a 36-month auto loan for $32,000 at 6% per year compounded monthly, we can easily find the monthly payment and the amortization of this loan on our calculator using the following procedures and keystrokes.

First, we find the monthly payment (see Table 8.13).

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 1 | Set all variables to defaults | 2ND [RESET] ENTER | RST | 0.00 |
| 2 | Set payments per year to 12 | 2ND [P/Y] 12 ENTER | P/Y = | 12.00 |
| 3 | Return to calculator mode | 2ND [QUIT] | | 0.00 |
| 4 | Enter number of payments with the payment multiplier | 3 2ND [xP/Y] N | N = | 36.00 |
| 5 | Enter annual interest rate | 6 I/Y | I/Y = | 6.00 |
| 6 | Enter loan amount | 32000 PV | PV = | 32,000.00 |
| 7 | Compute the monthly payment | CPT PMT | PMT = | -973.50 |

**Table 8.13 Calculator Steps to Find the Monthly Payment of a Loan**

We've verified the amount of our monthly debt service, including both the interest and repayment of the principal, as $973.50. The next step with our calculator is to verify our amortization at any point (see Table 8.14).

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 1 | Set previous work as an amortization worksheet | 2ND [AMORT] | P1 = | 1.00 |
| 2 | Set beginning period to 1 | 1 ENTER | P1 = | 1.00 |
| 3 | Set ending period to 12 | ↓ 12 ENTER | P2 = | 12.00 |
| 4 | Display amortization data at the end of month 12 | ↓ | BAL = | 21,965.02 |
| 5 | | ↓ | PRN = | -10,034.98 |
| 6 | | ↓ | INT = | -1,647.02 |

**Table 8.14 Calculator Steps to Verify Amortization at the End of One Year**

Without resetting the calculator, we will try a second example, this time reviewing the second full year of amortization at the end of 24 months (see Table 8.15).

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 1 | Set previous work as an amortization worksheet | 2ND [AMORT] | P1 = | 1.00 |
| 2 | Change beginning period to month 13 | 13 ENTER | P1 = | 13.00 |
| 3 | Change ending period to month 24 | ↓ 24 ENTER | P2 = | 24.00 |
| 4 | Display amortization data at the end of month 24 | ↓ | BAL = | 11,311.13 |
| 5 | | ↓ | PRN = | -10,653.89 |
| 6 | | ↓ | INT = | -1,028.11 |

**Table 8.15 Calculator Steps to Verify Amortization at the End of Two Years**

## Solving Time Value of Money Problems Using Excel

Microsoft's popular spreadsheet program Excel is arguably one of the most common and powerful numeric and data analysis products available. Yet while mastery of Excel requires extensive study and practice, enough basics can be learned in two or three hours to provide the user with the ability to solve problems quickly and conveniently, including extensive financial capability. Most of the calculations in this chapter were prepared with Excel.

The boxes in the Excel gridwork, known individually as cells (located at the intersection of a column and a row), can contain numbers, text, and very powerful formulas (or functions) for calculations and data analytics. Cells, rows, columns, and groups of cells (ranges) are easily moved, formatted, and replicated. In the mortgage amortization table for 240 months seen in Section 8.3.2, only the formulas for month 1 were typed in. With one simple command, that row of formulas was replicated 239 more times, with each line updating itself with relevant number adjustments automatically. With some practice, a long table such as that can be constructed by even a relatively new user in less than 10 minutes.

In this section, we will illustrate how to use Excel to solve problems from earlier in the chapter, including perpetuities, ordinary annuities, effective interest rates, and loan amortization. We will omit the basic dynamics of an Excel spreadsheet because they were presented sufficiently in preceding chapters.

Revisiting the constant perpetuity from Section 8.1, in which our shares of Shaw Inc., preferred stock pay an annual fixed dividend of $2.00 and the required rate of return is 7%, we do not use an Excel function for this simple operation. The two values are entered in cells B3 and B4, respectively.

We enter a formula in cell B6 to perform the division and display the result in that cell. The actual contents of cell B6 are typed below it for your reference, in cell B8 (see Figure 8.2).

| | A | B |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | **Indefinite Dividend per Share ($)** | 2.00 |
| 4 | **Required Rate of Return (%)** | 0.07 |
| 5 | | |
| 6 | **Price per Share** | $ 28.57 |
| 7 | | =B3/B4 |

**Figure 8.2 Excel Spreadsheet for Valuing a Perpetuity**

*Download the spreadsheet file (https://openstax.org/r/spreadsheet_file_Chapter08_finance) containing key Chapter 8 Excel exhibits.*

To find the present value of an ordinary annuity, we revisit Section 8.2.1. You will draw $25,000 at the end of each year for five years from a fund earning 8% annually, and you want to know how much you need in that fund today to accomplish this. We accomplish this in Excel easily with the PV function. The format of the PV command is

```
=PV(rate,periods,payment,0,0)
```

Only the first three arguments inside the parentheses are used. We'll place them in cells and refer to those cells in our PV function. As an option, you could also type the numbers into the parentheses directly. Notice the slight rounding error because of decimal expansion. Also, the payment must be entered as a negative number for your result to be positive; this can be accomplished either by making the $25,000 in cell B5 a negative amount or by placing a minus sign in front of the B5 in the formula's arguments. In cell B3, you must enter the percent either as 0.08 or as 8% (with the percent sign). We repeated the formula syntax and the actual formula inputs in column A near the result, for your reference (see Figure 8.3).

| | A | B |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | **Rate (%)** | 0.08 |
| 4 | **Periods** | 5 |
| 5 | **Payment** | (25,000) |
| 6 | | |
| 7 | **=PV(rate,periods,payment,0,0)** | $ 99,817.75 |
| 8 | **=PV(B3,B4,B5,0,0)** | |
| 9 | | |

**Figure 8.3 Excel Spreadsheet Showing the Present Value of an Ordinary Annuity**

We also found the present value of an annuity due. We use the same information from the ordinary annuity problem above, but you will recall that the first of five payments happens immediately at the start of year 1, not at the end. We follow the same procedures and inputs as in the previous example, but with one change to the PV function: the last argument in the parentheses will change from 0 to 1. This is a toggle switch that commands the PV function to treat this as an annuity due instead of an ordinary annuity (see Figure 8.4).

| | A | B |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | **Rate (%)** | 0.08 |
| 4 | **Periods** | 5 |
| 5 | **Payment** | (25,000) |
| 6 | | |
| 7 | **=PV(rate,periods,payment,0,1)** | $ 107,803.17 |
| 8 | **=PV(B3,B4,B5,0,1)** | |

**Figure 8.4 Excel Spreadsheet Showing the Present Value of an Annuity Due**

Section 8.2 introduced us to future values. Comparable to the PV function above, Excel provides the FV

function. Using the same information—$3,000 invested annually for five years, starting one year from now, at 4%—we'll solve using Excel (see Figure 8.5). The format of the command is

```
=FV(rate,periods,payment,0,0)
```

| | A | B |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | **Rate (%)** | 0.04 |
| 4 | **Periods** | 5 |
| 5 | **Payment** | (3,000) |
| 6 | | |
| 7 | **=FV(rate,periods,payment,0,0)** | $ 16,248.97 |
| 8 | **=FV(B3,B4,B5,0,0)** | |

**Figure 8.5 Excel Spreadsheet Showing the Future Value of an Ordinary Annuity**

As with present values, using the same data but solving for an annuity due requires the fifth argument inside the parentheses to be changed from 0 to 1; all other values remain the same (see Figure 8.6).

| | A | B |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | **Rate (%)** | 0.04 |
| 4 | **Periods** | 5 |
| 5 | **Payment** | (3,000) |
| 6 | | |
| 7 | **=FV(rate,periods,payment,0,1)** | $ 16,898.93 |
| 8 | **=FV(B3,B4,B5,0,1)** | |

**Figure 8.6 Excel Spreadsheet Showing the Future Value of an Annuity Due**

In Section 8.4, we explained the difference between stated and effective rates of interest to show the true cost of borrowing, in this case for a one-year period, if interest is compounded for periods within a year. The syntax for the Excel effect function to calculate this rate is

```
=EFFECT(rate,periods)
```

where *rate* is the nominal rate and *periods* represents the number of periods within a year.

Earlier, our example showed that 1.5% compounded monthly results in not 18% per year but actually over 19.56% (see Figure 8.7).

| | A | B | C |
|---|---|---|---|
| 1 | | | |
| 2 | | | |
| 3 | **Nominal Annual Rate** | 18.00% | |
| 4 | | | |
| 5 | | | |
| 6 | **Period Type** | **Periods per Year** | **Effective Interest** |
| 7 | Annual | 1 | 18.00% |
| 8 | Quarterly | 4 | 19.25% |
| 9 | Monthly | 12 | 19.56% |

**Figure 8.7 Excel Spreadsheet Showing Effective Interest Rate**

Note several things: First, the nominal interest rate is entered as a percent. Second, the actual effect function in C7 is typed as =EFFECT(rate,B7); we use the word *rate* because we actually assigned a name to cell B3, so Excel can use it in a function and replicate it without it changing. When cell C7 is replicated to C8 and C9, *rate* remains the same, but the formulas automatically adjust to use B8 and B9 for the periods.

To assign a name to a cell, keep in mind that every cell has column-row coordinates. We want cell B3 to be the anchor of our effective rate calculations. Rather than referring to cell B3, we can name it, and in this case, we use the name *rate*, which we can then use in formulas like any other Excel cell letter-number reference. Place the cursor in cell B3. Now, look at cell A1 on the grid: right above that cell, you see a box displaying B3, the current cursor location. If you click in that box and type “rate” (without the quotation marks), as we did, then hit the enter key, the value in that box will change to *rate*. Now, if you type “rate” (again, without quotation marks) into a formula, Excel knows to use the contents of cell B3.

Excel provides convenient tools for figuring out amortization. We’ll revisit our 36-month auto loan for $32,000 at 6% per year, compounded monthly. A loan amortization table for a fixed interest rate debt is usually formatted as follows, with the Interest and Principal columns interchangeable:

```
Period      Payment      Interest      Principal      Balance
```

In Excel, a table is completed by using the function PMT. The individual steps follow.

1. List the information about the loan in the upper left of the worksheet, and create the column headings for the schedule of amortization. Type “B5” (without the quotation marks) in cell E9 to begin the schedule. Then enter 1 for the first month under the Payment # (or Month) column, in cell A10 (see Figure 8.8).

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | | **Actual** | **Use** | | |
| 2 | **Annual Interest Rate** | 6% | 0.50% | | |
| 3 | **Years** | 3 | 36 | | |
| 4 | **Payments per Year** | 12 | | | |
| 5 | **Loan Amount** | $ 32,000 | | | |
| 6 | | | | | |
| 7 | | | | | Remaining |
| 8 | Payment # (or Month) | Payment | Interest | Principal | Balance |
| 9 | | | | | $32,000.00 |

**Figure 8.8 Step 1 of Creating an Amortization Table**

2. Next, in cell B10, the payment is derived from the formula =PMT(rate,periods,pv), with PV representing the present value, or the loan amount. Because we are compounding monthly, enter C$2 and C$3 for the rate

and periods, respectively. Cell B5 is used for the loan amount, but notice the optional minus sign placed in front of the entry B$5; this causes the results in the schedule to be displayed as positive numbers. The dollar sign ($) inserted in the cell references forces Excel to "freeze" those locations so that they don't attempt to update when we replicate them later; this is known in spreadsheet programs as an *absolute reference* (see Figure 8.9).

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | | **Actual** | **Use** | | |
| 2 | **Annual Interest Rate** | 6% | 0.50% | | |
| 3 | **Years** | 3 | 36 | | |
| 4 | **Payments per Year** | 12 | | | |
| 5 | **Loan Amount** | $ 32,000 | | | |
| 6 | | | | | |
| 7 | | | | | Remaining |
| 8 | Payment # (or Month) | **Payment** | Interest | Principal | Balance |
| 9 | | | | | 32,000.00 |
| 10 | 1 | **973.50** | | | |
| 11 | | **=PMT(C$2,C$3,-B$5)** | | | |

**Figure 8.9 Step 2 of Creating an Amortization Table**

3. The next step is to calculate the interest. We take the remaining balance from the previous line, in this case cell E9, and multiply it by the monthly interest rate in cell C2, typing C$2 to lock in the reference. The remaining balance of the loan should always be multiplied by this monthly percentage (see Figure 8.10).

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | | **Actual** | **Use** | | |
| 2 | **Annual Interest Rate** | 6% | 0.50% | | |
| 3 | **Years** | 3 | 36 | | |
| 4 | **Payments per Year** | 12 | | | |
| 5 | **Loan Amount** | $ 32,000 | | | |
| 6 | | | | | |
| 7 | | | | | Remaining |
| 8 | Payment # (or Month) | Payment | **Interest** | Principal | Balance |
| 9 | | | | | 32,000.00 |
| 10 | 1 | 973.50 | **160.00** | | |
| 11 | | | **=E9*C$2** | | |

**Figure 8.10 Step 3 of Creating an Amortization Table**

4. Because this is a fixed-rate loan, whatever is left from each payment after first deducting the interest represents principal, the amount by which the balance of the outstanding loan balance is reduced. Therefore, the contents of cell D10 represent B10, the total payment, minus C10, the interest portion (see Figure 8.11). No dollar signs are included because this cell reference can adjust to each row into which this formula is replicated, as will be seen in the following examples.

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | | **Actual** | **Use** | | |
| 2 | **Annual Interest Rate** | 6% | 0.50% | | |
| 3 | **Years** | 3 | 36 | | |
| 4 | **Payments per Year** | 12 | | | |
| 5 | **Loan Amount** | $ 32,000 | | | |
| 6 | | | | | |
| 7 | | | | | Remaining |
| 8 | Payment # (or Month) | Payment | Interest | **Principal** | Balance |
| 9 | | | | | 32,000.00 |
| 10 | 1 | 973.50 | 160.00 | **813.50** | |
| 11 | | | | **=B10-C10** | |

**Figure 8.11 Step 4 of Creating an Amortization Table**

5. Because our principal portion of the last payment has reduced our outstanding balance, it is subtracted from the preceding balance in cell E9 (see Figure 8.12). The command therefore is `=E9-D10`.

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | | **Actual** | **Use** | | |
| 2 | **Annual Interest Rate** | 6% | 0.50% | | |
| 3 | **Years** | 3 | 36 | | |
| 4 | **Payments per Year** | 12 | | | |
| 5 | **Loan Amount** | $ 32,000 | | | |
| 6 | | | | | |
| 7 | | | | | **Remaining** |
| 8 | Payment # (or Month) | Payment | Interest | Principal | **Balance** |
| 9 | | | | | 32,000.00 |
| 10 | 1 | 973.50 | 160.00 | 813.50 | **31,186.50** |
| 11 | | | | | **=E9-D10** |

**Figure 8.12 Step 5 of Creating an Amortization Table**

Now that the first full row is defined, an amortization schedule is easily developed by Excel's replication abilities. Place the cursor on cell A10, hold down the left mouse button, and drag the cursor to cell E10. Cells A10 through E10 in row 10 should now be highlighted. Release the mouse button. Then "grab" the tiny square symbol at the bottom right of cell E10 and drag it downward as far as you need; in this case, you'll need 35 more rows because this is a 36-month loan, so it will end at row 45. We added a line for totals.

This is now a complete loan amortization schedule (see Figure 8.13). The first several periods display, followed by the last few periods, to prove that the schedule is complete (data rows for month 4 to month 22 are hidden).

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | | **Actual** | **Use** | | |
| 2 | **Annual Interest Rate** | 6% | 0.50% | | |
| 3 | **Years** | 3 | 36 | | |
| 4 | **Payments per Year** | 12 | | | |
| 5 | **Loan Amount** | $ 32,000 | | | |
| 6 | | | | | |
| 7 | | | | | **Remaining** |
| 8 | **Payment # (or Month)** | **Payment** | **Interest** | **Principal** | **Balance** |
| 9 | | | | | 32,000.00 |
| 10 | 1 | 973.50 | 160.00 | 813.50 | 31,186.50 |
| 11 | 2 | 973.50 | 155.93 | 817.57 | 30,368.93 |
| 12 | 3 | 973.50 | 151.84 | 821.66 | 29,547.27 |
| 42 | (continued) | | | | |
| 43 | 33 | 973.50 | 19.23 | 954.27 | 2,891.54 |
| 44 | 34 | 973.50 | 14.46 | 959.04 | 1,932.50 |
| 45 | 35 | 973.50 | 9.66 | 963.84 | 968.66 |
| 46 | 36 | 973.50 | 4.84 | 968.66 | 0.00 |
| 47 | **Totals** | **$ 35,046.07** | **$ 3,046.07** | **$ 32,000.00** | |

**Figure 8.13 Completed Amortization Schedule**

This will look familiar; it's the same amortization table used as a proof in Section 8.3 (see Table 8.4). There is no rounding error because Excel uses the full decimal expansion in its calculations.

This chapter has explored the time value of money by expanding on the concepts discussed in Time Value of Money I with additional funds being periodically added to or subtracted from our investment, either compounding or discounting them according to the situation. In all cases, the payments in the stream were identical. If they had not been identical, a separate set of operators would be required, and these will be addressed in the next chapter.

# Summary

## 8.1 Perpetuities

A perpetuity is an investment that is intended to provide an expected return indefinitely, either remaining constant or growing by an incremental amount. Preferred stock is a common example with a preestablished dividend formula. An indefinite stream of payments cannot be compounded into a future value, but it can be discounted to a present value, providing an opportunity to determine the amount an investor should be willing to pay for a share of that stock.

## 8.2 Annuities

An annuity is a stream of fixed periodic payments that is expected to be paid or received. Calculations of future value or present value are commonly performed on these payment streams for a wide number of reasons in business and personal financial analysis, as seen in the chapter focusing on single amounts, particularly in loan repayment. Annuities may be ordinary annuities, in which the first cash flow of a series occurs at the end of the first period, or annuities due, if the first cash flow occurs at the beginning point of the first period.

## 8.3 Loan Amortization

Loans are contracts between a lender and a borrower. Failure to observe the rules of that contract, such as payment of interest or repayment of the amount owed, can subject the borrower to substantial penalties as well as damage to their credit. Loan agreements bearing a fixed rate of interest have a scheduled amortization, or rate and time of repayments with interest. Several types of business and personal loans were described.

## 8.4 Stated versus Effective Rates

For a borrower to understand the true cost of financing, they must be familiar with interannual compounding, which can cause a stated interest rate that appears to be annual to actually be higher. The effective rate of interest was demonstrated to understand that true cost.

## 8.5 Equal Payments with a Financial Calculator and Excel

The use of two tools for managing and understanding the time value of money and its many applications was discussed: a professional financial calculator and the popular Microsoft Office Suite spreadsheet application Excel.

# Key Terms

**annuity** a stream of regular, periodic payments to be received or paid

**annuity due** a stream of periodic payments in which the payment or receipt occurs at the beginning of each period

**constant perpetuity** a stream of periodic payments that is expected to continue indefinitely with no change in the amount paid or received

**discount rate** an interest rate used in time value of money calculations to determine present value; may derive from several sources, such as stated contract rates, costs to borrow, or expected rates of return on investments

**effective interest rate** the interest rate that results when compounding occurs multiple times within a year; the true cost of borrowing

**growing perpetuity** a stream of periodic payments that is expected to continue indefinitely with growth of the amount paid or received in the future, usually by a fixed percentage

**loan amortization** the scheduling of periodic repayment of a debt, typically involving regular payments or receipts of amounts that include both interest payment and repayment of the principal of the amount owed

**lump sum** a single cash payment made in lieu of a series of future payments, such as a lottery payout or a

legal settlement

**ordinary annuity** a stream of periodic payments in which the payment or receipt occurs at the end of each period

**perpetuity** a stream of periodic payments that is expected to continue indefinitely

**preferred stock** shares of ownership in a corporation that typically entitle the holder to a fixed dividend per share, if declared by the corporation, with priority over holders of that corporation's common stock

**required rate of return** the minimum amount of return that an investor will accept on an investment given the level of risk involved

**retirement planning** the process of determining one's objectives for retirement, including one's finances, and developing strategies and tactics to achieve them

**structured settlements** monetary legal settlements that are paid out in installments, such as an annuity, rather than a lump sum cash amount

## CFA Institute

This chapter supports some of the Learning Outcome Statements (LOS) in this CFA® Level I Study Session (https://openstax.org/r/CFA_Level_I_Study_Session2). Reference with permission of CFA Institute.

## Multiple Choice

1. The best example of a constant perpetuity would most likely be _____.
   **a.** an annuity due
   **b.** dividends from common stock
   **c.** preferred stock
   **d.** an ordinary annuity

2. You wish to endow a university chair of accounting for a salary of $100,000 per year to the recipient. The university will withdraw $100,000 each year for the recipient's salary. The amount of your gift will remain untouched indefinitely, in perpetuity. The university can lock in a fixed rate for your investment of 2.8% per year. In order to achieve this, what is the approximate amount of the gift you would have to make now?
   **a.** $3,103,569
   **b.** $3,571,429
   **c.** $4,101,218
   **d.** $4,227,827

3. Preferred stock in Blue Agate Inc. is issued for dividends of $3.00 per share. The dividends will increase each year at 0.178%, a growing perpetuity. The required rate of return on a stock such as this is 2.5%. At what approximate price will this preferred stock most likely sell today?
   **a.** $117.21
   **b.** $119.87
   **c.** $120.00
   **d.** $129.20

4. Julio's attorney negotiates a structured settlement after an injury, consisting of seven equal payments to Barry of $150,000 each. The first payment is due today, and the remaining payments will be received in annual amounts, with the second payment occurring one year from now. What is the approximate value of this settlement in today's dollars if Barry uses a discount rate of 5%?
   **a.** $911,352
   **b.** $867,960
   **c.** $746,235
   **d.** $1,050,000

5. What is the approximate present value of an ordinary annuity (beginning one year from now) of a stream

of 12 annual payments of $87,000 if you use a discount rate of 6%?

**a.** $773,154.04
**b.** $747,278.92
**c.** $729,394.95
**d.** $718,974.58

**6.** If Maria invests $2,700 at the end of each six-month period for six years at an annual rate of 4%, what is the approximate future value of her ordinary annuity? Review Chapter 7 for the techniques of interannual compounding.

**a.** $17,909.10
**b.** $20,248.23
**c.** $31,755.54
**d.** $36,212.67

**7.** Assume all of the same facts as in exercise 6 above, except that Maria begins immediately and makes each of her payments at the beginning of each 6-month period instead of the end. What is the approximate future value of her annuity due at the end of the six years?

**a.** $17,909.10
**b.** $36,936.92
**c.** $32,707.24
**d.** $22,997.88

**8.** Rather than spending her $48,000 in casino winnings, Christy places the money in an investment that will earn her 5% per year, compounded annually. She will withdraw the money in four equal annual installments beginning one year from today. What must the approximate amount of each annual withdrawal be for this investment to be fully depleted in four years?

**a.** $11,136.38
**b.** $12,892.56
**c.** $12,243.47
**d.** $13,536.61

**9.** Your friend Jamal borrows $5,000 from you, agreeing to pay you back with 8% annual interest, with the first payment due to you one year from today. You ask that you be fully repaid over the next four years. However, to lower his annual payment, Jamal asks you to extend the period over five full years instead. What will be the approximate **difference** in his total payments to you, including interest and principal, if the debt is amortized over five years rather than four?

**a.** Jamal will pay $544 less.
**b.** Jamal will pay $544 more.
**c.** Jamal will pay $223 less.
**d.** Jamal will pay $223 more.

**10.** Your new El Supremo credit card arrangement indicates that you will owe interest on unpaid balances at a nominal (stated) rate of 1.2% per month. If the interest rate is compounded monthly, what is the approximate effective annual rate of interest?

**a.** 15.39%
**b.** 12.00%
**c.** 14.02%
**d.** 14.40%

## Problems

*Use four decimal places on time value of money factors unless otherwise specified. Approximations and minor differences because of rounding are acceptable. Ignore the effect of taxes. Assume that all percentages are*

*annual rates and that compounding occurs annually unless indicated otherwise.*

1. Steve purchases preferred stock in Berklee Corporation, with each share paying a $2.50 dividend. This dividend will remain constant. If the public's required rate of return for Berklee stock is 8%, at what price should this company's stock sell?
2. Donna enters into an investment contract that will guarantee her 4% per year if she deposits $3,500 each year for the next 10 years. She must make the first deposit one year from today, the day she signs the agreement. How much will she have when she makes her last payment 10 years from now?
3. Assume the same facts as in problem 2 above, except that Donna negotiates the chance to make her first payment now and continue to pay at the beginning of each year for the 10-year period. How much will she have accumulated?
4. Bill will receive a royalty payment of $18,000 per year for the next 25 years, beginning one year from now, as a result of a book he has written. If a discount rate of 10 percent is applied, should he be willing to sell out his future rights now for $160,000? How about $162,500? $165,000?
5. Debbie won the $60 million lottery. She is to receive $1 million a year for the next 50 years beginning one year from now, plus an additional lump sum payment of $10 million after 50 years. The discount rate is 10 percent. How much cash would she need to be offered today to tempt her to take a lump-sum cash offer instead, all things equal?
6. Kim started a paper route on January 1, 2016. Every three months, she deposited $300 in her new bank account, which earned 4 percent annually but was compounded quarterly. On December 31, 2019, she placed the entire balance in her bank account in an investment that earned 5 percent annually. How much will she have on December 31, 2022?
7. You hire Thomas to work for you for five years, and you agree to put away enough money as a lump sum now to fund an annuity for him. At the end of those five years, he will retire and may begin drawing out $20,000 per year for five years, starting on the last day of each year (in this case, the end of year 6, from when this arrangement began, through year 10). How much must you invest today if your guaranteed interest rate is 3% compounded annually for all 10 years?
8. Your new boss doesn't have a pension or 401(k) plan for your retirement, but she agrees to place aside $12,000 every year once a year for four years. She gives you the option of either starting immediately on your first day of work or starting one year from now. That makes this the difference between an ordinary annuity and an annuity due. If the plan earns 5% per year, compounded annually, what will be the difference between the two approaches after the four years / four payments?
9. Jada is borrowing $40,000 from you today. She agrees to pay you back in annual installments beginning a year from now over eight years, with interest at 3%. What would her annual payment amount be, including both interest and principal?
10. You agree to finance your new SUV with an auto loan of $38,000. This loan will be repaid over three years with monthly payments (and compounding) at a 4% annual interest rate (0.33% per month). What will your monthly loan payment be?

## Video Activity

### Future Value of Ordinary Annuities

Access multimedia content (http://openstax.org/books/principles-finance/pages/8-video-activity)

1. What is the primary difference between this demonstration and our chapter examples, keeping the chapter "Time Value of Money I" in mind?
2. Explain the significance of Dr. van Biezen's comment at 4:32 regarding a difference when payments are

made at the beginning of each pay period rather than the end.

## Practical Example of Annuities

Access multimedia content (http://openstax.org/books/principles-finance/pages/8-video-activity)

3. What is the primary difference between a fixed annuity and a variable annuity?
4. Annuities are often recommended to retirees and seniors. Why would a fixed annuity be more attractive to such a person than a variable annuity?

9

# Time Value of Money III: Unequal Multiple Payment Values

**Figure 9.1** Capital investment in production equipment such as this robotic arm requires extensive analysis of the benefits the investment is likely to produce over time. (credit: modification of "Webb Telescope Crew Flexes Robotic Arm at NASA" by Chris Gunn/NASA/flickr, CC BY 2.0)

## Chapter Outline


**9.1** Timing of Cash Flows
**9.2** Unequal Payments Using a Financial Calculator or Microsoft Excel


## Why It Matters

Baseball legend Ted Williams once said, "Baseball is the only field of endeavor where a man can succeed three times out of ten and be considered a good performer."[1] On routine or unimportant decisions, business managers might aspire to do as well as Ted Williams, making the right decisions only 30% of the time. But a professional decision maker must "hit it out of the park" when making major capital investment choices and recommendations.

As a student in a course of business studies and career development, it is highly likely that you will be a decision maker about projects that are likely to generate future cash flows but will also require a large initial expense. When you ask your manager to invest $500,000 or more in a new piece of equipment that could help your department meet or exceed its goals, you must be prepared to defend your request. Competing managers and departments will be asking for similar funding, and there simply might not be enough for everyone. This decision process requires financial analysis.

Mark Cuban of *Shark Tank* fame enjoys citing the series' catchphrase: "Know thy numbers." As a business professional, you must be able to assess potential profit against expenditures to be successful. In most cases, this is based on our understanding of *cash flow*. A major capital investment might seem initially like a gamble, but it is a gamble that can be hedged in your favor with understanding, analysis, and knowledge of your numbers.

The purpose of this chapter is to give you information and instruction on how this is done. The techniques we will discuss in this chapter will clarify decisions that must be made in the process of investing in a business. We

1 Pete Palmer and Gary Gillette, eds. *The 2006 ESPN Baseball Encyclopedia*. New York: Sterling Publishing, 2006, 5.

focus first on decisions we make about our own money as investors if uneven cash receipts or payments are involved.

# 9.1 Timing of Cash Flows

## Learning Outcomes

By the end of this section, you will be able to:

- Describe how multiple payments of unequal value are present in everyday situations.
- Calculate the future value of a series of multiple payments of unequal value.
- Calculate the present value of a series of multiple payments of unequal value.

## Multiple Payments or Receipts of Unequal Value: The Mixed Stream

At this point, you are familiar with the time value of money of single amounts and annuities and how they must be managed and controlled for business as well as personal purposes. If a stream of payments occurs in which the amount of the payments changes at any point, the techniques for solving for annuities must be modified. Shortcuts that we have seen in earlier chapters cannot be taken. Fortunately, with tools such as financial or online calculators and Microsoft Excel, the method can be quite simple.

The ability to analyze and understand **cash flow** is essential. From a personal point of view, assume that you have an opportunity to invest $2,000 every year, beginning next year, to save for a down payment on the purchase of your first home seven years from now. In the third year, you also inherit $10,000 and put it all toward this goal. In the fifth year, you receive a large bonus of $3,000 and also dedicate this to your ongoing investment.

The stream of regular payments has been interrupted—which is, of course, good news for you. However, it does add a new complexity to the math involved in finding values related to time, whether compounding into the future or discounting to the present value. Analysts refer to such a series of payments as a **mixed stream**. If you make the first payment on the first day of next year and continue to do so on the first day of each following year, and if your investment will always be earning 7% interest, how much cash will you have accumulated—principal plus earned interest—at the end of the seven years?

This is a future value question, but because the stream of payments is mixed, we cannot use annuity formulas or approaches and the shortcuts they provide. As noted in previous chapters, when solving a problem involving the time value of money, a timeline and/or table is helpful. The cash flows described above are shown in Table 9.1 . Remember that all money is assumed to be deposited in your investment at the beginning of each year. The cumulative cash flows do not yet consider interest.

| Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| Cash Invested | $0.00 | $2,000 | $2,000 | $2,000 | $12,000 | $2,000 | $5,000 | $2,000 |
| Cumulative Cash Flows | | $2,000 | $4,000 | $6,000 | $18,000 | $20,000 | $25,000 | $27,000 |

**Table 9.1**

By the end of seven years, you have invested $27,000 of your own money before we consider interest:

- Seven years times $2,000 each year, or $14,000
- The extra $10,000 you received in year 3 (which is invested at the start of year 4)
- The extra $3,000 you received in year 5 (which is invested at the start of year 6)

These funds were invested at different times, and time and interest rate will work for you on all accumulated balances as you proceed. Therefore, focus on the line in your table with the cumulative cash flows. How much cash will you have accumulated at the end of this investment program if you're earning 7% compounded annually? You could use the *future value of a single amount* equation, but not for an annuity. Because the

amount invested changes, you must calculate the future value of each amount invested and add them together for your result.

Recall that the formula for finding the future value of a single amount is $\text{FV} = \text{PV} \times (1 + i)^n$, where FV is the future value we are trying to determine, PV is the value invested at the start of each period, *i* is the interest rate, and *n* is the number of periods remaining for compounding to take effect.

Let us repeat the table with your cash flows above. Table 9.2 includes a line to show for how many periods (years, in this case) each investment will compound at 7%.

| Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| Cash Invested | $0.00 | $2,000 | $2,000 | $2,000 | $12,000 | $2,000 | $5,000 | $2,000 |
| Cumulative Cash Flows | | $2,000 | $4,000 | $6,000 | $18,000 | $20,000 | $25,000 | $27,000 |
| Years to Compound | | 7 | 6 | 5 | 4 | 3 | 2 | 1 |

**Table 9.2**

The $2,000 that you deposit at the start of year 1 will earn 7% interest for the entire seven years. When you make your second investment at the start of year 2, you will now have spent $4,000. However, the interest from your first $2,000 investment will have earned you $\$2{,}000 \times 0.07 = \$140$, so you will begin year 2 with $4,140 rather than $4,000.

Before we complicate the problem with a schedule that ties everything together, let's focus on years 1 and 2 with the original formula for the future value of a single amount. What will your year 1 investment be worth at the end of seven years?

$$\text{FV}_1 = \$2{,}000 \times (1 + 0.07)^7 \approx \$3{,}211.56 \quad \textbf{9.1}$$

You need to address the year 2 investment separately at this point because you've calculated the year 1 investment and its compounding on its own. Now you need to know what your year 2 investment will be worth in the future, but it will only compound for six years. What will it be worth?

$$\text{FV}_2 = \$2{,}000 \times (1 + 0.07)^6 \approx \$3{,}001.46 \quad \textbf{9.2}$$

You can perform the same operation on each of the remaining five invested amounts, remembering that you invest $12,000 at the start of year 4 and $5,000 at the start of year 6, as per the table. Here are the five remaining calculations:

$$\begin{aligned} \text{FV}_3 &= \$2{,}000 \times (1 + 0.07)^5 \approx \$2{,}805.10 \\ \text{FV}_4 &= \$12{,}000 \times (1 + 0.07)^4 \approx \$15{,}729.55 \\ \text{FV}_5 &= \$2{,}000 \times (1 + 0.07)^3 \approx \$2{,}450.09 \\ \text{FV}_6 &= \$5{,}000 \times (1 + 0.07)^2 \approx \$5{,}724.50 \\ \text{FV}_7 &= \$2{,}000 \times (1 + 0.07)^1 \approx \$2{,}140.00 \end{aligned} \quad \textbf{9.3}$$

Notice how the exponent representing *n* decreases each year to reflect the decreasing number of years that each invested amount will compound until the end of your seven-year stream. For clarity, let us insert each of these amounts in a row of Table 9.3 :

| Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| Cash Invested | $0.00 | $2,000 | $2,000 | $2,000 | $12,000 | $2,000 | $5,000 | $2,000 |
| Cumulative Cash Flows | | $2,000 | $4,000 | $6,000 | $18,000 | $20,000 | $25,000 | $27,000 |

**Table 9.3**

| Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| Years to Compound | | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Compounded Value at End of Year 7 | | $3,211.56 | $3,001.46 | $2,805.10 | $15,729.55 | $2,450.09 | $5,724.50 | $2,140.00 |

**Table 9.3**

The solution to the original question—the value of your seven different investments at the end of the seven-year period—is the total of each individual investment compounded over the remaining years. Adding the compounded values in the bottom row provides the answer: $35,062.26. This includes the $27,000 that you invested plus $8,062.26 in interest earned by compounding.

It's important to note that throughout these sections on the time value of money and compounded or discounted values of mixed streams and their analysis, we are placing the valuation at the end or beginning of a period for simplicity in the examples. In reality, businesses might consider valuations happening within the period to allow for a degree of regularity in the revenue streams provided by the asset being considered. However, because this is a technique of forecasting, which is inherently uncertain, we will continue with analysis by period.

## THINK IT THROUGH

### Future Value of a Mixed Stream

Assume that you can invest five annual payments of $10,000, beginning immediately, but you believe you will be able to invest additional amounts of $5,000 at the beginning of years 4 and 5. This investment is expected to earn 4% each year. What is the anticipated future value of this investment after the full five years?

**Solution:**

| Year | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Cash Invested | $0.00 | $10,000 | $10,000 | $10,000 | $15,000 | $15,000 |
| Cumulative Cash Flows | | $10,000 | $20,000 | $30,000 | $45,000 | $60,000 |
| Years to Compound | | 5 | 4 | 3 | 2 | 1 |
| Compounded Value at End of Year 5 | | $12,166.53 | $11,698.59 | $11,248.64 | $16,224.00 | $15,600.00 |

**Table 9.4**

The equations to calculate each individual year's compounded value at the end of the five years are as follows:

$$\begin{aligned} \text{FV}_1 &= \$10{,}000 \times (1+0.04)^5 \approx \$12{,}166.53 \\ \text{FV}_2 &= \$10{,}000 \times (1+0.04)^4 \approx \$11{,}698.59 \\ \text{FV}_3 &= \$10{,}000 \times (1+0.04)^3 \approx \$11{,}248.64 \\ \text{FV}_4 &= \$15{,}000 \times (1+0.04)^2 \approx \$16{,}224.00 \\ \text{FV}_5 &= \$15{,}000 \times (1+0.04)^5 \approx \$15{,}600.00 \end{aligned} \quad \textbf{9.4}$$

The sum of these individual calculations is $66,937.76, which is the total value of this stream of invested amounts plus compounded interest.

Let's take the example above and review it from a different angle. Keeping in mind that we have not yet explored the use of Excel, is there another way to view our solution? The problem above takes each annual investment and compounds it into the future, then adds the results of each calculation to find the total future value of the stream of payments.

But when you break the problem down, another way to look at the problem is as a five-year annuity of $10,000 per year *plus* added payments in years 4 and 5. Can we solve for the future value of an annuity first and then perform two separate calculations on the additional amounts ($5,000 each in years 4 and 5)? Yes, we can.

Let's summarize:

- Future value of a $10,000 annuity due, 4%, 5 years, *plus*
- Future value of a single payment of $5,000, 4%, 2 years, *plus*
- Future value of a single payment of $5,000, 4%, 1 year

This must give us the same result. The formula for the future value of an annuity due is

$$\text{FVa} = \text{PYMT} \times \frac{(1+i)^n - 1}{i} \times (1 + \text{i}) \tag{9.5}$$

This problem can be solved in the three steps of the summary above.

Step 1:

$$\text{FVa} = \$10{,}000 \times \frac{(1+0.04)^5 - 1}{0.04} \times (1 + 0.04) \tag{9.6}$$

$$\text{FVa} = \$10{,}000 \times 5.416323 \times 1.04 \approx \$56{,}329.76 \tag{9.7}$$

Step 2:

$$\text{FV}_{\text{Year 4}} = \$5{,}000 \times (1 + 0.04)^2 = \$5{,}408.00 \tag{9.8}$$

Step 3:

$$\text{FV}_{\text{Year 5}} = \$5{,}000 \times (1 + 0.04)^1 = \$5{,}200.00 \tag{9.9}$$

Combining the results from each of the three steps gives us

$$56{,}329.76 + 5{,}408.00 + 5{,}200.00 = \$66{,}937.76 \tag{9.10}$$

It works. Whether you view this problem as five separate periods that can be compounded separately and then combined or as a combination of one or more annuities and/or single payment problems, we always arrive at the same solution if we are diligent about the time, the interest, and the stream of payments.

## The Present Value of a Mixed Stream

Now that we've seen the calculation of a **future value**, consider a **present value**. We will begin with a personal example. You win a cash windfall through your state's lottery. You would like to take a portion of the funds and place them in a fixed investment so that you can draw $17,000 per year starting one year from now and continue to do so for the next two years. At the end of year 4, you want to withdraw $17,500, and at the end of year 5, you will withdraw the last $18,000 to close the account. When you take your last payment of $18,000, your fund will be totally depleted. You will always be earning 6% annually. How much of your cash windfall should you set aside today to accomplish this?

Let us break down the problem, remembering that we are thinking in reverse from the earlier problems that involved future values. In this case, we're bringing future values back in time to find their present values. You will recall that this process is called *discounting* rather than *compounding*.

Regardless of how we solve this, the question remains the same: How much money must we invest today (present value) to achieve this? And remember that we will always be earning 6% compounded annually on any invested balances.

We are calculating present values as we did in previous chapters, given a known future value "target," in order to determine how much money you need today to achieve that goal. Let us break this down by first reviewing the relevant equations from previous chapters.

Present value of an ordinary annuity:

$$\text{PVa} = \text{PYMT} \times \frac{\left[1 - \frac{1}{(1+i)^n}\right]}{i} \tag{9.11}$$

Present value of a single amount:

$$\text{PV} = \text{FV} \times \frac{1}{(1+i)^n} \tag{9.12}$$

where PVa is the present value of an annuity, PYMT is one payment in a consistent stream (an annuity), $i$ is the interest rate (annual unless otherwise specified), $n$ is the number of periods, PV is the present value of a single amount, and FV is the future value of a single amount.

You want to find out how much money you need to set aside today to accomplish your goal. You can also find out how much money you need to set aside in each period to accomplish this goal. Therefore, we can address this problem in increments. Let us look at potential solutions.

First, we will break this down into the cash flows of each year. Table 9.5 shows the timing of the future cash flows you're expecting:

| Year | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Expected Amount to Be Withdrawn at End of Year | $0.00 | $17,000 | $17,000 | $17,000 | $17,500 | $18,000 |

**Table 9.5**

One method is to take each year's cash flows, which happen at the end of the year, and discount them to today using the present value formula for a single amount:

$$\text{PV} = \text{FV} \times \frac{1}{(1+i)^n} \tag{9.13}$$

$$\text{PV}_1 = \$17{,}000 \times \frac{1}{(1+0.06)^1} \approx \$16{,}037.74 \tag{9.14}$$

Because year 1's withdrawal from your fund only has one year to earn interest, we discounted it for one year. The second amount is discounted for two years:

$$\text{PV}_2 = \$17{,}000 \times \frac{1}{(1+0.06)^2} \approx \$15{,}129.94 \tag{9.15}$$

The next three years are discounted in the same way, for three, four, and five years, respectively:

$$\begin{aligned} \text{PV}_3 &= \$17{,}000 \times \frac{1}{(1+0.06)^3} \approx \$14{,}273.53 \\ \text{PV}_4 &= \$17{,}500 \times \frac{1}{(1+0.06)^4} \approx \$13{,}861.64 \\ \text{PV}_5 &= \$18{,}000 \times \frac{1}{(1+0.06)^5} \approx \$13{,}450.65 \end{aligned} \tag{9.16}$$

Notice how we reverse our thinking on the exponent $n$ from our approach to future value. This time, it increases each period because we discount each future amount for a longer period to arrive at the value in today's dollars.

When we add all five discounted present value amounts from above, we derive today's value of $72,753.49. Expressed more simply, if you wanted to extract the specified stream of cash flows at the end of each year

($17,000 for three years, then $17,500, then $18,000), you would have to begin with $72,753.49. The thing to remember is that any amounts remaining in this fund, regardless of how you deplete it, will always be earning 6% annually. See Table 9.6.

| Year | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Withdrawn at End of Year | | $17,000.00 | $17,000.00 | $17,000.00 | $17,500.00 | $18,000.00 |
| Interest on Balance | | $4,365.21 | $3,607.12 | $2,803.55 | $1,951.76 | $1,018.87 |
| Remaining Balance | $72,753.49 | $60,118.70 | $46,725.82 | $32,529.37 | $16,981.13 | $0.00 |

**Table 9.6**

Let us try another approach. Because the amount of cash withdrawn in the first three years remains constant at $17,000, it can be viewed as an annuity—specifically, a three-period annuity of $17,000 and two single payments of $17,500 and $18,000. Therefore, we could also discount (bring to present value) an annuity of $17,000 for three years (the first three) and then combine it with the year 4 discounted amount and the year 5 discounted amount. We can try it using the formulas for PVa and PVused above. In Step 1, we will discount the first three years as an annuity (ordinary, as the first withdrawal is not made until one year from now); in Step 2, we will discount the year 4 single payment amount; and in Step 3, we will do the same for the year 5 single payment amount. Then we can add them together.

Step 1: Find the present value of the annuity using the PVa formula:

$$\text{PVa} = \$17{,}000 \times \frac{\left[1 - \frac{1}{(1 + 0.06)^3}\right]}{0.06} \tag{9.17}$$

$$\text{PVa} = \$17{,}000 \times \frac{1 - 0.839619}{0.06} \tag{9.18}$$

$$\text{PVa} = \$17{,}000 \times 2.673017 \approx \$45{,}441.29 \tag{9.19}$$

Step 2: Discount the year 4 amount using the formula for the present value of a single amount:

$$\text{PV}_{(\text{Year } 4)} = \$17{,}500 \times \frac{1}{(1 + 0.06)^4} \approx \$13{,}861.64 \tag{9.20}$$

Step 3: Perform the same operation as in Step 2 for the year 5 amount:

$$\text{PV}_{(\text{Year } 5)} = \$18{,}000 \times \frac{1}{(1 + 0.06)^5} \approx \$13{,}450.65 \tag{9.21}$$

Now that all three amounts have been discounted to today's value, we can add them:

$$45{,}441.20 + 13{,}861.64 + 13{,}450.65 = \$72{,}753.49 \tag{9.22}$$

Calculating the present value of cash flows is very common and critical in the analysis of **capital investments** in business for two compelling reasons: first, the investment is likely quite significant, and second, the risk will usually encompass a longer time frame. When the author of this chapter would purchase a large machine, it would likely take several years for that machine to justify its purchase with the revenues it would generate. This is one of the primary reasons that accountants require us to depreciate the cost of an asset over time: to assess the cost against the time it will take for that asset to produce profits and cash flow.

## THINK IT THROUGH

### Present Value of a Mixed Stream

Assume that you decide to invest $450,000. All cash flows are discounted at 4%. You are told by your financial advisor to expect cash inflows from your investment of $100,000 in year 1, $125,000 in year 2, $175,000 in year 3, $90,000 in year 4, and $50,000 in year 5. Would you agree to this plan based only on the numbers? Each amount will be withdrawn at the end of every year, and interest will be compounded annually.

**Solution:**

| Year | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Expected Amount to Be Withdrawn at End of Year | $0.00 | $100,000 | $125,000 | $175,000 | $90,000 | $50,000 |

**Table 9.7**

Applying the formula for the present value of a single amount, we discount each amount and then add the discounted amounts. We will simplify this approach with Excel shortly, but we must understand the reasoning behind discounting uneven cash flow streams with a direct solution.

$$\begin{aligned} PV_1 &= \$100{,}000 \times \frac{1}{(1+0.04)^1} \approx \$96{,}153.85 \\ PV_2 &= \$125{,}000 \times \frac{1}{(1+0.04)^2} \approx \$115{,}569.53 \\ PV_3 &= \$175{,}000 \times \frac{1}{(1+0.04)^3} \approx \$155{,}574.36 \\ PV_4 &= \$90{,}000 \times \frac{1}{(1+0.04)^4} \approx \$76{,}932.38 \\ PV_5 &= \$50{,}000 \times \frac{1}{(1+0.04)^5} \approx \$41{,}096.36 \end{aligned} \quad \textbf{9.23}$$

By combining the five discounted amounts above, we get a total present value of $485,326.48. This amount represents the value today of the five expected cash inflows for as long as our remaining balance is earning 4%.

## CONCEPTS IN PRACTICE

### Thoughts on Cash Flow from Irina Simmons

In 2013, the author interviewed Irina Simmons, senior vice president, chief risk officer, and former treasurer of EMC Corporation. The importance and understanding of cash flow analysis is fundamental to this text, and several of her insights are highly relevant to our content and procedures here.

**AA:** Ms. Simmons, why is cash management so important to an existing or start-up firm, and how does it compare to the more basic and traditional focus on profitability?

**Simmons:** While profitability is very useful for analysis by investors to measure performance, an organization's cash flow provides superior measurement. Cash flow is easy to understand, provides a transparent way of assessing a firm's health, and is not subject to any qualifications. By focusing upon cash flow, any firm—whether it is mature or a start-up organization—can have a clear picture of its health and success.

**AA:** In your bio, you mention liquidity management. Can you elaborate on this and why liquidity

management is so important to a firm?

**Simmons:** Just as effective forecasting can provide superior cash management, the same holds true for liquidity management. For example, if you are able to confidently predict levels and timing of cash, then based on that forecast, you can make effective short- and long-term borrowing decisions. A disciplined approach to projecting one's cash position means that instead of investing cash in the money market to maximize day-to-day liquidity, you can look into longer-term investments that can provide a significantly higher return. This is essential to the effective matching of cash inflows and outflows for the firm.

**AA:** In summary, do you have any words of advice to students who might have an eye to entrepreneurial ventures?

**Simmons:** "Cash is king," don't forget that. Understand how cash moves through a business. It is also very important to implement and retain a cash management discipline. Never put that off until later. Many times, start-ups will say, "Well, I have all this venture money, and we can start making things happen and worry about being good cash managers later." But what I've seen is that the longer companies wait, the harder it is to break bad habits. Making cash management a priority now will serve entrepreneurs in perfect stead as their business starts to gain traction.

We closed this excellent interview with agreement that we were "kindred spirits" regarding the importance of cash flow analysis, including capital decisions such as those mentioned in this chapter. We confirmed with each other the core belief that "cash flow is the axis upon which the world of business spins."

(source: *Business Finance: A Clear View*, 3rd edition, by Alan S. Adams. LAD Publishing, 2015.)

LINK TO LEARNING

Analyst Training Materials

These materials, developed to help professionals prepare for an analyst certification exam, describe the sources of return from investing in a bond (https://openstax.org/r/return-investing-bond).

# 9.2 Unequal Payments Using a Financial Calculator or Microsoft Excel

## Learning Outcomes

By the end of this section, you will be able to:

- Calculate unequal payments using a financial calculator.
- Calculate unequal payments using Microsoft Excel.

## Using a Financial Calculator

A financial calculator provides utilities to simplify the analysis of uneven mixed cash streams (see Table 9.8).

Earlier, we explored the future value of a seven-year mixed stream, with $2,000 being saved each year, plus an additional $10,000 in year 4 and an additional $3,000 in year 6. All cash flows and balances earn 7% per year compounded annually, and the payments are made at the start of each year. We proved that this result totals approximately $35,062.26. We begin by clearing all memory functions and then entering each cash flow as follows:

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 1 | Clear cash flow memory | CF 2ND [CLR WORK] | CF0 | 0.00 |
| 2 | Enter 0 for cash flow at Time 0 | ENTER ↓ | CF0 | 0.00 |
| 3 | Move to next entry | ↓ | C01 | 0.00 |
| 4 | Enter first cash flow | 2000 ENTER | C01 = | 2000.00 |
| 5 | Move to next entry | ↓ ↓ | C02 | 0.00 |
| 6 | Enter second cash flow | 2000 ENTER ↓ | C02 = | 2000.00 |
| 7 | Move to next entry | ↓ ↓ | C03 | 0.00 |
| 8 | Enter third cash flow | 2000 ENTER | C03 = | 2000.00 |
| 9 | Move to next entry | ↓ ↓ | C04 | 0.00 |
| 10 | Enter fourth cash flow | 12000 ENTER | C04 = | 12000.00 |
| 11 | Move to next entry | ↓ ↓ | C05 | 0.00 |
| 12 | Enter fifth cash flow | 2000 ENTER | C05 = | 2000.00 |
| 13 | Move to next entry | ↓ ↓ | C06 | 0.00 |
| 14 | Enter sixth cash flow | 5000 ENTER | C06 = | 5000.00 |
| 15 | Move to next entry | ↓ ↓ | C07 | 0.00 |
| 16 | Enter seventh cash flow | 2000 ENTER | C07 = | 2000.00 |
| 17 | Press NPV | NPV | I | 0.00 |
| 18 | Enter interest rate | 7 ENTER | I = | 7.00 |
| 19 | Press down arrow to show current NPV rate | ↓ | NPV | 0.00 |
| 20 | Press CPT to find net present value | CPT | NPV | 20,406.56 |

**Table 9.8 Steps for Calculating Uneven Mixed Cash Flows**[2]

At this point, we have found the net present value of this uneven stream of payments. You will recall, however, that we are not trying to calculate present values; we are looking for future values. The TI BA II Plus™ Professional calculator does not have a similar function for future value. This means that either we can find the future value for each payment in the stream and combine them, or we can take the net present value we just calculated and easily project it forward using the following keystrokes. Note the net present value solution in Step 20 above. We will use that and then use the simpler of the two approaches to calculate future value (see Table 9.9).

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 21 | Enter NPV from Step 20 | 20406.56 | PV = | 20,406.56 |
| 22 | Enter number of compounding periods | 8 N | N = | 8.00 |
| 23 | Enter interest rate | 7 I/Y | I/Y = | 7.00 |
| 24 | Calculate future value | CPT FV | FV = | -35,062.27 |

**Table 9.9 Steps for Calculating Uneven Mixed Cash Flows, Continued**

2 The specific financial calculator in these examples is the Texas Instruments BA II Plus™ Professional model, but you can use other financial calculators for these types of calculations.

This is consistent with the solution we found earlier, with a difference of one cent due to rounding error.

We may also use the calculator to solve for the present value of a mixed cash stream. Earlier in this chapter, we asked how much money you would need today to fund the following five annual withdrawals, with each withdrawal made at the end of the year, beginning one year from now, and all remaining money earning 6% compounded annually:

| Year | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| | $17,000 | $17,000 | $17,000 | $17,500 | $18,000 |

**Table 9.10**

We determined these withdrawals to have a total present value of $72,753.30. Here is an approach to a solution using a financial calculator. In this example, we will store all cash flows in the calculator and perform an operation on them as a whole (see Table 9.11). Because we will use the NPV function (to be explored in more detail in a later chapter), we enter our starting point as 0 because we do not withdraw any cash until one year after we begin.

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 1 | Clear cash flow memory | CF 2ND [CLR WORK] | CF0 | 0.00 |
| 2 | Enter 0 for cash flow at Time 0 | ENTER ↓ | CF0 | 0.00 |
| 3 | Move to next entry | ↓ | C01 | 0.00 |
| 4 | Enter first cash flow | 17000 ENTER | C01 = | 17000.00 |
| 5 | Move to next entry | ↓ ↓ | C02 | 0.00 |
| 6 | Enter second cash flow | 17000 ENTER | C02 = | 17000.00 |
| 7 | Move to next entry | ↓ ↓ | C03 | 0.00 |
| 8 | Enter third cash flow | 17000 ENTER | C03 = | 17000.00 |
| 9 | Move to next entry | ↓ ↓ | C04 | 0.00 |
| 10 | Enter fourth cash flow | 17500 ENTER | C04 = | 17500.00 |
| 11 | Move to next entry | ↓ ↓ | C05 | 0.00 |
| 12 | Enter fifth cash flow | 18000 ENTER | C05 = | 18000.00 |
| 13 | Press NPV | NPV | I | 0.00 |
| 14 | Enter interest rate | 6 ENTER | I = | 6 |
| 15 | Press down arrow to show current NPV rate | ↓ | NPV | 0.00 |
| 16 | Press CPT to find net present value | CPT | NPV = | 72,753.49 |

**Table 9.11 Steps for Calculating the Present Value of a Mixed Cash Stream**

This result, you will remember, was calculated earlier in the chapter by the formula approach.

## Using Microsoft Excel

Several of the exhibits already in this chapter have been prepared with Microsoft Excel. While full mastery of Excel requires extensive study and practice, enough basics can be learned in two or three hours to provide the user with the ability to quickly and conveniently solve problems, including extensive financial applications. Potential employers and internship hosts have come to expect basic Excel knowledge, something to which you are exposed in college.

We will demonstrate the same two problems using Excel rather than a calculator:

1. The future value of a mixed cash stream for a seven-year investment
2. The present value of a mixed cash stream of five withdrawals that you wish to make from a fund to be established today

Beginning with the future value problem, we created a simple matrix to lay out the mixed stream of future cash flows, starting on the first day of each year, with all funds earning 7% throughout. Our goal is to determine how much money you will have saved at the end of this seven-year period.

Table 9.12 repeats the data from earlier in the chaper for your convenience.

| Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| Cash Invested | $0.00 | $2,000 | $2,000 | $2,000 | $12,000 | $2,000 | $5,000 | $2,000 |
| Cumulative Cash Flows | | $2,000 | $4,000 | $6,000 | $18,000 | $20,000 | $25,000 | $27,000 |
| Years to Compound | | 7 | 6 | 5 | 4 | 3 | 2 | 1 |

**Table 9.12**

Figure 9.2 is an Excel matrix that parallels Table 9.12 above.

| | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Assumed Interest Rate | | 7.00% | | | | | | | |
| 2 | **Year** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **Total** |
| 3 | Amount Invested at Start of Year | | 2,000.00 | 2,000.00 | 2,000.00 | 12,000.00 | 2,000.00 | 5,000.00 | 2,000.00 | **27,000.00** |
| 4 | Interest on Balance | | 140.00 | 289.80 | 450.09 | 1,321.59 | 1,554.10 | 2,012.89 | 2,293.79 | **8,062.27** |
| 5 | Cumulative Cash Flow | | 2,140.00 | 4,429.80 | 6,879.89 | 20,201.48 | 23,755.58 | 30,768.47 | 35,062.27 | **35,062.27** |

**Figure 9.2 Compound Interest Example**

*Download the spreadsheet file (https://openstax.org/r/chapter9-excel-exhibits) containing key Chapter 9 Excel exhibits.*

We begin by entering the cash flow as shown in Figure 9.2. The assumed interest rate is 7%. The interest on the balance is calculated as the amount invested at the start of the year multiplied by the assumed interest rate. The cumulative cash flows of each year are calculated as follows: for year 1, the amount invested plus the interest on the balance; for years 2 through 7, the amount invested plus the interest on the balance plus the previous year's running balance. By adding up the amount invested and the interest on the balance, you should arrive at a total of $35,062.27.

We can use Excel formulas to solve time value of money problems. For example, if we wanted to find the present value of the amount invested at 7% over the seven-year time period, we could use the NPV function in Excel. The dialog box for this function (Rate, Value 1, Value2) is shown in Figure 9.3.

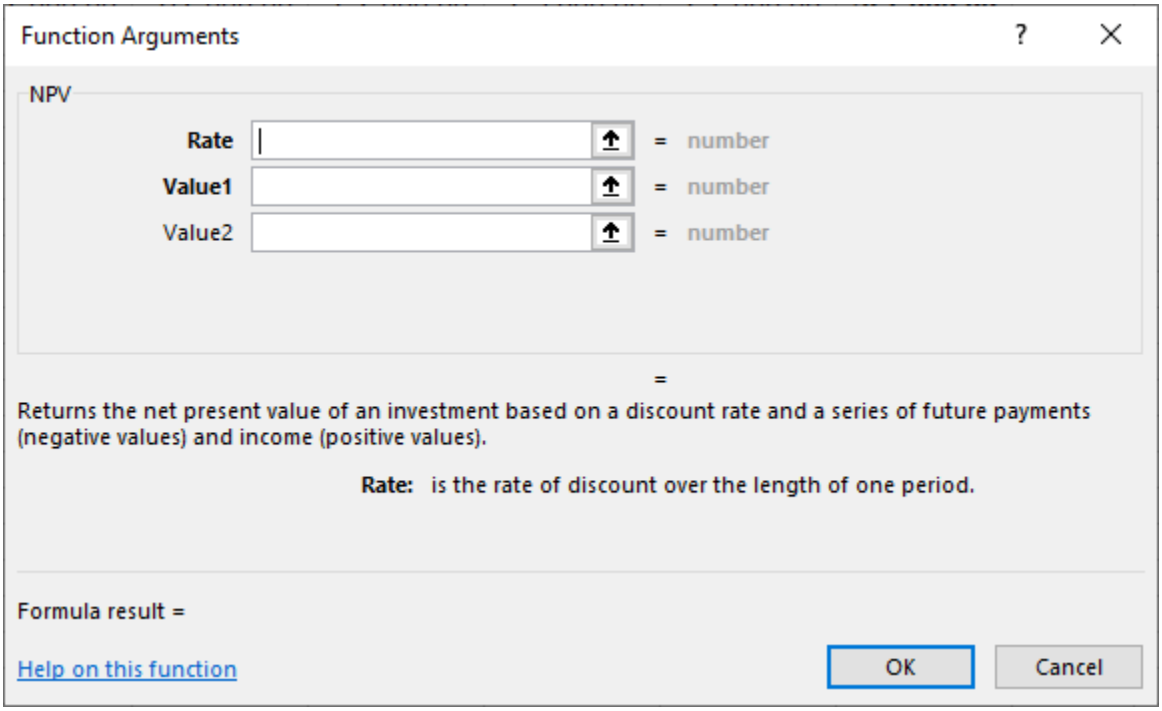


**Figure 9.3 Dialog Box for NPV Function, Problem 1**

The function argument Rate is the interest rate; Value1, Value2, and so on are the cash flows; and "Formula result" is the answer.

We can apply the NPV function to our problem as shown in Figure 9.4.

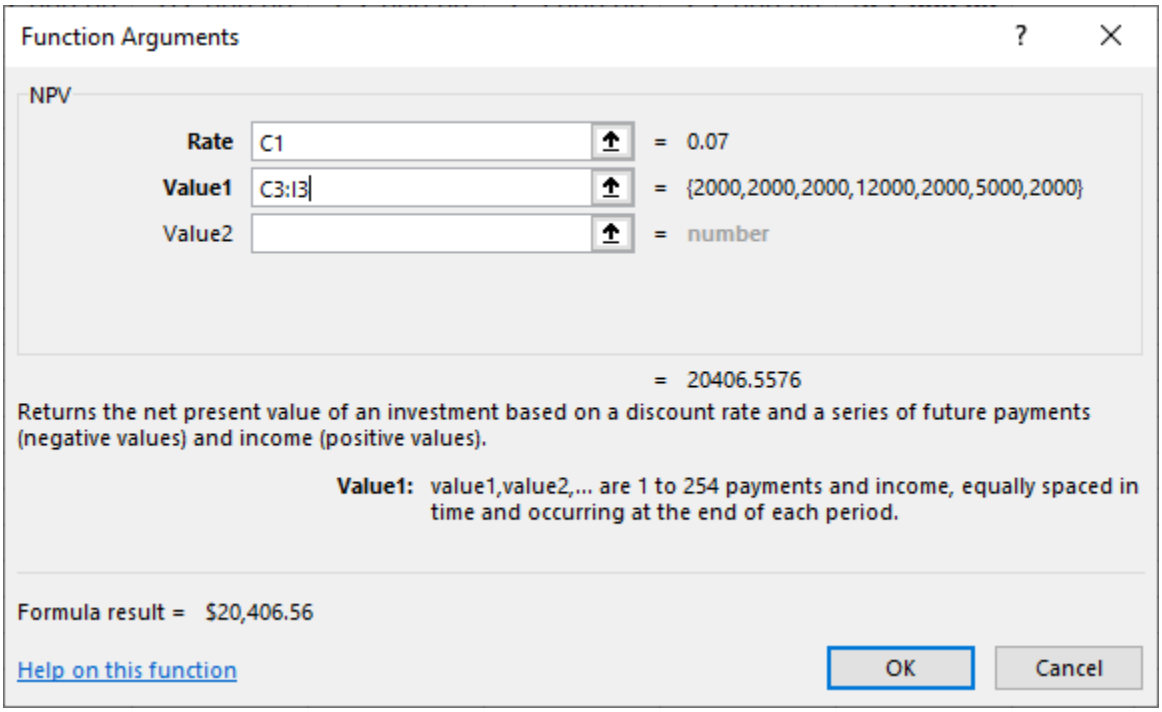


**Figure 9.4 Applying the NPV Function, Problem 1**

Please note that the Rate cell value (C1) and the Value1 cell range (C3:I3) will vary depending on how you set up your spreadsheet.

The non-Excel version of the problem, using an assumed interest rate of 7%, produces the same result.

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Amount Invested at Start | $2,000 | $2,000 | $2,000 | $12,000 | $2,000 | $5,000 | $2,000 |
| NPV | $20,406.56 | | | | | | |

**Table 9.13**

We conclude with the second problem addressed earlier in this chapter: finding the present value of an uneven stream of payments. We can use Excel's NPV function to solve this problem as well (see Figure 9.5).

| Year | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Expected Amount to Be Withdrawn at End of Year | $0.00 | $17,000 | $17,000 | $17,000 | $17,500 | $18,000 |

**Table 9.14**

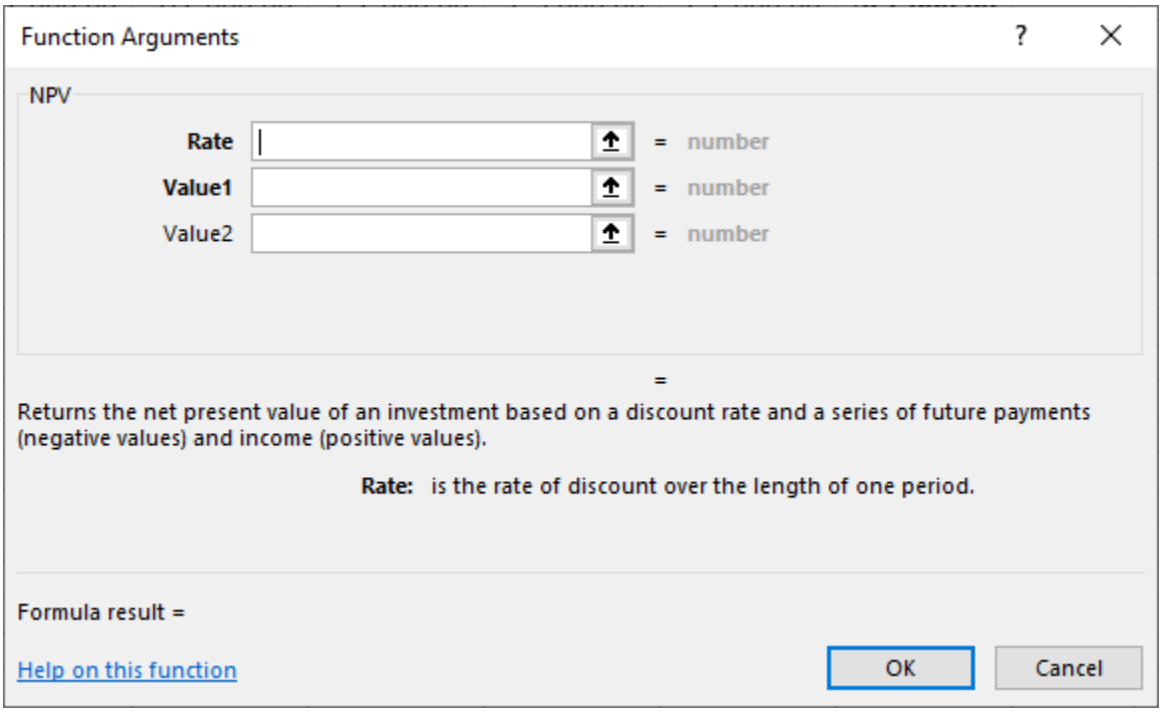


**Figure 9.5 Dialog Box for NPV Function, Problem 2**

Again, Rate is the interest rate; Value1, Value 2, and so on are the cash flows; and "Formula result" is the answer.

Let us apply the NPV function to our problem, as shown in Figure 9.6 and Figure 9.7.

| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| 1 | **Year** | **0** | **1** | **2** | **3** | **4** | **5** |
| 2 | Desired Withdrawals Each Year | | 17,000.00 | 17,000.00 | 17,000.00 | 17,500.00 | 18,000.00 |
| 3 | Interest Rate | 6.00% | | | | | |
| 4 | | **NPV** | **72,753.49** | | | | |

**Figure 9.6 Applying the NPV Function, Problem 2: Excel Data**

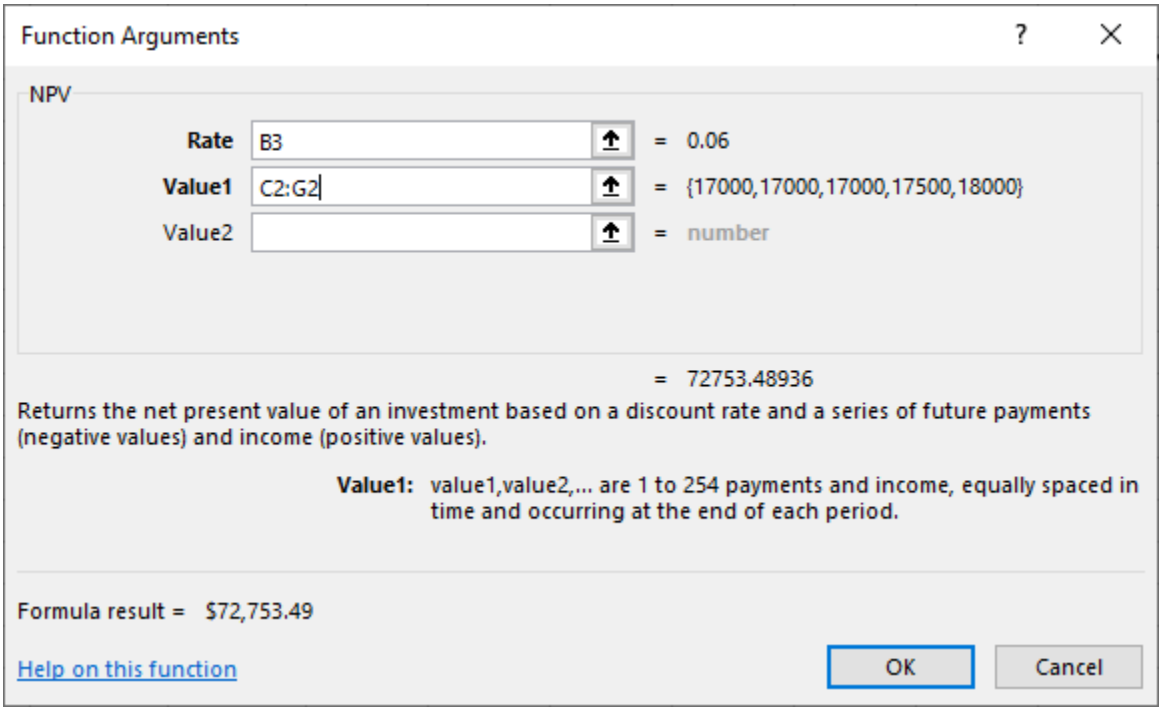


**Figure 9.7 Applying the NPV Function, Problem 2: Function Argument**

Please note that the Rate cell value (B3) and the Value1 cell range (C2:G2) will vary depending on how you set up your spreadsheet.

The non-Excel version of the problem produces the same result: an NPV of $72,753.49.

| Year | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Desired Withdrawals Each Year | $17,000 | $17,000 | $17,000 | $17,500 | $18,000 | |
| Interest Rate | 0.06 | | | | | |
| **NPV** | | | | | | **$72,753.49** |

**Table 9.15**

# Summary

## 9.1 Timing of Cash Flows

To understand the true value and strength of cash, it is necessary to consider its timing. This is relevant for investments for the future and for analyses of the value of projects that require investment today to produce expected flows of cash later. These future cash flows could involve inflows or outflows of cash in unequal amounts. This section analyzed the determination of present and future value of these uneven or mixed cash flows.

## 9.2 Unequal Payments Using a Financial Calculator or Microsoft Excel

This section discussed the use of two tools for managing and understanding the time value of money and its many applications when the flows of cash are unequal: the TI BA II Plus™ Professional financial calculator and the spreadsheet application Excel.

# Key Terms

**capital investment** a major expenditure that requires a large up-front investment and is expected to generate substantial cash inflow in return

**cash flow** the amount of cash actually flowing into and out of a business, as opposed to *income* (which is based on accounting rules, accruals, and reports)

**future value** the value of an asset or holding at a point in the future based on expectations of that asset's growth at a certain rate of return

**mixed stream** a set of cash flows over a period of time that can vary in amount from one period to the next

**present value** the value of an asset in today's dollars based on future growth expectations at an assumed interest rate

# CFA Institute

This chapter supports some of the Learning Outcome Statements (LOS) in this CFA® Level I Study Session (https://openstax.org/r/cfa-level1-study-session). Reference with permission of CFA Institute.

# Multiple Choice

General instructions: Approximations and minor differences because of rounding are acceptable. Ignore the effect of taxes. Please assume that all percentages are annual rates and compounding occurs annually unless otherwise indicated.

1. For which of the following situations would you NOT be able to use the one-step shortcut provided by an annuity calculation?
   a. Planning an amortization table for a three-year car loan at 2%
   b. Investing $2,000 per year for 10 years at 5%
   c. Calculating the monthly payment on a 20-year home mortgage of $150,000 at 3%
   d. Finding the present value of a fund that will pay $1,000 the first year, $2,000 in the second year, and $3,500 in the third year

2. If you invest $3,000 today, $5,000 one year from now, and $3,000 two years from now, approximately how much money will you have at the end of the third year if you invest in a fund paying 7%?
   a. $11,770.24
   b. $12,609.63
   c. $13,187.79
   d. $14,274.50

3. You intend to invest four annual payments, starting immediately: $10,000 now, another $10,000 at the end

of year 1, $12,000 at the end of year 2, and $15,000 at the end of year 3. How much will you have at the end of year 4 if the fund is always earning 6% compounded annually?

**a.** $53,918.13
**b.** $54,417.52
**c.** $57,685.30
**d.** $57,894.77

4. You can invest a windfall of $40,000 today at 4% compounded annually. You don't believe you can make another investment one year from now, but you believe that you can save enough that two years from now, you can deposit another $10,000 in the same investment, which will still be earning 4% compounded annually. How much will you have accumulated in this investment three years from now?

**a.** $50,400.00
**b.** $54,875.32
**c.** $55,394.56
**d.** $57,123.33

5. Donna can invest today in a fund that will guarantee her a 5% return compounded annually for five years. She can invest $1,200 today, $1,400 one year from now, $1,800 two years from now, and $2,100 three years from now. If she can make these investments as scheduled, how much will she have accumulated five years from now?

**a.** $6,878.97
**b.** $7,632.23
**c.** $8,142.52
**d.** $8,799.49

6. Jane wants to create a fund today that will provide her a 4% guaranteed compounded annual rate. She wants to withdraw $15,000 one year from now and $27,000 two years from now, after which the fund will be depleted. How much must she invest today to achieve this goal?

**a.** $42,400.00
**b.** $41,912.43
**c.** $40,775.89
**d.** $39,386.10

7. You wish to draw from a fund you're creating today with a 3% guaranteed compounded annual rate. You hope to withdraw $40,000 one year from now, $35,000 two years from now, and $25,000 three years from now, at which point the fund will be depleted. How much must you invest today to achieve this?

**a.** $94,704.35
**b.** $95,346.98
**c.** $95,255.12
**d.** $95,945.78

## Review Questions

1. Refer to Question 3 above. Solve using the financial calculator, documenting your steps/keystrokes.
2. Refer to Question 7 above. Solve using the financial calculator, documenting your steps/keystrokes.
3. You agree to repay a loan over five years with the following stream of cash payments: $1,000; $1,100; $1,250; $1,280; and $1,300. If you wish to discount these payments to their present value today using 4%, why can you not use one annuity calculation, as seen in previous chapters?

## Problems

1. Your aunt promises to gift you $1,500 now, $1,700 one year from now, $1,900 two years from now, and

$2,500 three years from now. You will deposit all four amounts in an account that bears 3% interest compounded annually. How much will be in the account at the end of the fourth year?

2. You believe that you can set aside $1,200 each year for the next four years, starting immediately, in order to buy a small fishing boat for your retirement. Your friend Luis promises that he'll pay you back $4,900 that he owes you three years from now, so you will add that to the payment you make at the start of year 4. Then, at the start of year 5, you will increase your payment to $1,400; in year 6, to $1,500; and in year 7, to $1,600. Every payment will be deposited in a fund bearing 4% interest compounded annually. How much will you have set aside for your boat at the end of the seventh year?
3. Assume you win a lottery that will pay you $10,000 immediately, plus $20,000 one year from now, $30,000 two years from now, $40,000 three years from now, and $75,000 four years from now. You're curious about how much the lottery commission might offer you as an immediate lump sum instead. What is the minimum amount you should consider accepting today instead? Use a 5% annual discount rate. Please remember that we are ignoring taxation and other considerations and basing this only on the math itself.
4. Assume you win a lottery, and you are offered the following stream of payments by the lottery commission: $25,000 today, $32,000 one year from now, another $32,000 two years from now, and a final payment of $55,000 three years from now. You accept the offer. If you invest all of these proceeds at 6% compounded annually and extract nothing from the investment, how much will you have at the end of the fourth year?
5. You are offered a business partnership that guarantees you cash returns of $150,000 one year from now, nothing at the end of year 2, and $350,000 at the end of year 3. After year 3, the partnership will be dissolved, and there will be no more expected returns on your investment. If you analyze this plan expecting 7% compounded annually, what is this potential deal worth to you today?
6. Tony owns a small business that he is attempting to sell. A potential buyer offers him $500,000 today, plus $1,500,000 two years from now and a balance of $1,700,000 three years from now. Tony always analyzes cash flows using a rate of 4% compounded annually. To compare this to other offers, which would be paid in cash immediately, he wants to know the present value of these future cash flows. Show the calculation and solution that you would present to Tony to use in his decision.
7. Continuing Problem 6 above, assume that as Tony receives each payment from the buyer, he can immediately invest it in a fund that returns a guaranteed 3.5% compounded annually. If he accepts the terms of this offer, how much will he have accumulated in this investment four years from now?
8. You hire Susan for a three-year term. She has no retirement plan, so you agree to invest money immediately to allow her a stream of three payments beginning one year after her employment term ends. Draw a timeline! The money you invest for the full six years of this arrangement (three years of employment and three years of withdrawals) always earns 4% compounded annually. When Susan receives her third and last payment, the fund will be depleted and equal zero. The three payments she will receive are as follows:
   - End of year 4: $25,000
   - End of year 5: $30,000
   - End of year 6: $37,000

   Therefore, your goal is to have enough money in this account at the end of Susan's three-year employment term to assure her of receiving these payments.

   How much money must you invest today to accomplish this strategy?
9. Abby owns a business that projects two years of strong cash flow, followed by a two-year hiatus while she pursues a graduate degree. She then plans to resume her business and is confident about the following two years of cash flow. At the end of each year, she will invest her profits in a fund that returns 3%

compounded annually. Each investment will be made at the end of the year. Her expected investments are as follows:

- Year 1: $50,000
- Year 2: $78,000
- Year 3: 0
- Year 4: 0
- Year 5: $84,000
- Year 6: $89,000

If Abby meets her expectations, how much money will she have in this fund at the end of year 7?

## Video Activity

### Calculate the Present Value for Multiple Cash Flows

Access multimedia content (http://openstax.org/books/principles-finance/pages/9-video-activity)

1. Provide a practical example from your own personal financial management of why an understanding of the present value of future cash flows would be important.

2. You expect to receive $10,800 one year from now, $17,400 two years from now, nothing at the end of the third year, and $24,000 four years from now. If you discount all of your cash flows at 7%, then with annual compounding, what are these future cash amounts worth to you in total today?

### Future Value of Uneven Cash Flows

Access multimedia content (http://openstax.org/books/principles-finance/pages/9-video-activity)

3. Using Excel, determine the future value of this series of expected unequal receipts five years from now if each payment is received at the end of each year, beginning one year from now, and the interest rate is 6% compounded annually.
   - End of year 1: $3,800
   - End of year 2: $4,400
   - End of year 3: $5,100
   - End of year 4: $5,800

4. When using Excel's built-in Future Value function, why does Dr. Konners enter dollar amounts as negative numbers?

10

# Bonds and Bond Valuation

**Figure 10.1** Bonds are very useful investments to add to a portfolio. (credit: modification of "US Treasury Checks - 3D Illustration" by DonkeyHotey/flickr, CC BY 2.0)

## Chapter Outline


**10.1** Characteristics of Bonds
**10.2** Bond Valuation
**10.3** Using the Yield Curve
**10.4** Risks of Interest Rates and Default
**10.5** Using Spreadsheets to Solve Bond Problems


## Why It Matters

When an investor purchases a bond, that person is, for all intents and purposes, making a loan to the bond issuer. Bonds issues are used to raise funds and can be issued by corporations, governments, or even subagencies of governments (including local municipalities).

As with any type of loan, the borrowing party is expected to offer something to the lender in exchange for their time and trouble. In this case, the bond-issuing entity will agree not only to repay the original face value of the loan on a specific date (the maturity of the bond) but also to pay the lender interest—or, in bond terminology, coupon payments.

Coupon payments are designed to make a bond purchase more acceptable for investors by helping compensate them for the time value of money. Because investors are parting with money that they have right now in order to make the initial bond purchase but will not see repayment of principal until the maturity date of the bond, they will experience the negative impact of time value over the bond term. When a bond issuer offers periodic coupon payments, this helps offset the negative effect of the delayed receipt of the principal amount for the investor. Also, because coupon payments will be coming to the investor throughout the term of the bond, essentially in installment payments (an annuity), the time value of money plays a critical role in bond transactions and in calculating bond valuation.

Bonds, along with stocks and mutual funds, are considered to be one of the most basic financial instruments available to any investor. It is quite common for investors to round out their portfolios by purchasing bonds,

adding a degree of safety and diversity to their investment mix.

# 10.1 Characteristics of Bonds

## Learning Outcomes

By the end of this section, you will be able to:

- List and define the basic characteristics of bonds.
- List and describe the various types of bonds available.
- Explain how a bond price is inversely related to its return (yield).

## Bonds as Investments

One way to look at bond investments is to consider the fact that any investor who purchases a bond is essentially buying a future cash flow stream that the bond issuer (or borrower) promises to make as per agreement.

Because bonds provide a set amount of cash inflow to their owners, they are often called fixed-income securities. Thus, future cash flows from the bond are clearly stated per agreement and fixed when the bond sale is completed.

Bonds are a basic form of investment that typically include a straightforward financial agreement between issuer and purchaser. Nevertheless, the terminology surrounding bonds is unique and rather extensive. Much of the specialized vocabulary surrounding bonds is designed to convey the concept that a bond is similar to other financial instruments in that it is an investment that can be bought and sold. Much of this unique terminology will be covered later in this chapter, but we can set out some of the basics here with an example.

Let's say that you buy a $1,000 bond that was issued by Apple Inc. at 5% interest, paid annually, for 20 years. Here, you are the lender, and Apple Inc. is the borrower.

LINK TO LEARNING

### Informational Basics on Bonds

This video (https://openstax.org/r/the-basics-of-bonds) from *MoneyWeek* editor Tim Bennett provides information about the basics of bonds—what they are, how they work, why companies and governments issue them, and why investors might buy them.

## Basic Terminology

We need to know the following basic bond terms and pricing in order to apply the necessary time value of money equation to value this Apple, Inc. bond issue:

- **Par value**: A bond will always clearly state its par value, also called face amount or face value. This is equal to the principal amount that the issuer will repay at the end of the bond term or maturity date. In our example, the par value of the bond is $1,000.
- **Coupon rate**: This is the interest rate that is used to calculate periodic interest, or coupon payments, on the bond. It is important to note that coupon rates are always expressed in annual terms, even if coupon payments are scheduled for different periods of time. The most common periods for coupon payments other than annual are semiannual and quarterly. Coupon rates will typically remain unchanged for the entire life of the bond. In our example, the coupon rate is the 5% interest rate.
- **Coupon payment**: This refers to the regular interest payment on the bond. The coupon or periodic interest payment is determined by multiplying the par value of the bond by the coupon rate. It is important to note that no adjustment needs to be made to the coupon rate if the bond pays interest

annually. However, if a bond pays interest on a semiannual or quarterly basis, the coupon rate will have to be divided by 2 or 4, respectively, to convert the stated annual rate to the correct periodic rate. In our example, coupons are paid annually, so the periodic or annual interest that is paid is equal to $\$1{,}000 \times 0.05 = \$50$. You may notice that because these payments are the same amount and made at regular intervals, they constitute an annuity stream (refer to Time Value of Money II: Equal Multiple Payments.

- **Maturity date**: The maturity date is the expiration date of the bond, or the point in time when the term of a bond comes to an end. On the maturity date, the issuer will make the final interest or coupon payment on the bond and will also pay off its principal, or face value. In our example, the maturity date is at the end of the 20-year period.
- **Yield to maturity (YTM)**: The YTM is essentially the discount rate used to bring the future cash flows of a bond into present value terms. It also equals the return that the investor will receive if the bond is held to maturity. The YTM helps quantify the overall investment value of a bond. We will explore how to compute this rate later in the chapter.

Table 10.1 displays a selected listing of bonds available for purchase or sale. First, let's review the columns so you can learn how to read this table.

| Issuer | Bond Type | Current Price % | Callable? | Coupon Rate % | Maturity Date | Yield% | Rating |
|---|---|---|---|---|---|---|---|
| 3M Co. | Corp | 105.120 | Yes | 2.25 | 9/19/2026 | 1.240 | A+ |
| Alteryx | Corp | 98.818 | No | 1.00 | 8/1/2026 | 1.206 | None |
| Anheuser-Busch Cos. LLC | Corp | 125.319 | Yes | 5.95 | 1/25/2033 | 3.340 | BBB+ |
| City of Chicago | Muni | 103.164 | Yes | 5.00 | 1/1/2033 | 1.030 | BBB+ |
| Coca-Cola Co. | Corp | 95.206 | Yes | 1.00 | 3/15/2028 | 1.731 | A+ |
| DuPont De Nemours Inc. | Corp | 100.815 | Yes | 2.17 | 5/1/2023 | 1.775 | BBB+ |
| Exxon Mobil Corp. | Corp | 107.325 | Yes | 3.18 | 3/15/2024 | 0.483 | AA- |
| Ford Motor Co. | Corp | 114.880 | No | 7.13 | 11/15/2025 | 3.623 | BB+ |
| Nordstrom Inc. | Corp | 112.905 | No | 6.95 | 3/15/2028 | 4.758 | BB+ |
| Tennessee Energy Acquisition Corp. | Muni | 102.168 | No | 5.25 | 9/1/2021 | 0.451 | BBB+ |

**Table 10.1 Bond Information, March 2021** (source: FINRA-Markets.Morningstar.com)

- **Column 1: Issuer.** The first column shows the company, city, or state issuing the bond. This bond listing includes two municipal issuers (City of Chicago and Tennessee Energy) as well as several corporate issuers.
- **Column 2: Bond Type.** This describes the issue of the bond and indicates whether it is a corporation or a municipality.
- **Column 3: Current Price.** The third column shows the price as a percent of par value. It is the price someone is willing to pay for the bond in today's market. We quote the price in relation to $100. For example, the Nordstrom bond is selling for 112.905% of its par value, or $112.905 per $100.00 of par value. If this bond has a $1,000.00 par value, it will sell for $\$1{,}129.05$ ($\$1{,}000 \times 1.12905$). Note: Throughout this chapter, we use $1,000 as the par value of a bond because it is the most common par value for corporate bonds.
- **Column 4: Callable?** This column states whether or not the bond has a call feature (if it can be retired or ended before its normal maturity date).
- **Column 5: Coupon Rate.** The fifth column states the coupon rate, or annual interest rate, of each bond.
- **Column 6: Maturity Date.** This column shows the maturity date of the issue—the date on which the corporation will pay the final interest installment and repay the principal.

- **Column 7: Yield.** The seventh column indicates each bond's yield to maturity—the yield or investment return that you would receive if you purchased the bond today at the price listed in column 3 and held the bond to maturity. We will use the YTM as the discount rate in the bond pricing formula.
- **Column 8: Rating.** The final column gives the bond rating, a grade that indicates credit quality. As we progress through this chapter, we will examine prices, coupon rates, yields, and bond ratings in more detail

## Types of Bonds

There are three primary categories of bonds, though the specifics of these different types of bond can vary depending on their issuer, length until maturity, interest rate, and risk.

### Government Bonds

The safest category of bonds are short-term **US Treasury bills (T-bills)**. These investments are considered safe because they have the full backing of the US government and the likelihood of **default** (nonpayment) is remote. However, T-bills also pay the least interest due to their safety and the economics of risk and return, which state that investors must be compensated for the assumption of risk. As risk increases, so should return on investment. Treasury notes are a form of government security that have maturities ranging from one to 10 years, while Treasury bonds are long-term investments that have maturities of 10 to 30 years from their date of issue.

**Savings bonds** are debt securities that investors purchase to pay for certain government programs. Essentially, the purchase of a US savings bond involves the buyer loaning money to the government with a guaranteed promise that they will earn back the face value of the bond plus a certain amount of interest in the future. Savings bonds are backed by the US government, meaning that there is virtually no possibility of the buyer losing their investment. For this reason, the return on savings bonds is relatively low compared to other forms of bonds and investments.

LINK TO LEARNING

Government Bonds

Review this introductory video (https://openstax.org/r/treasury-bonds-prices) about government bonds.

**Municipal bonds ("munis")** are issued by cities, states, and localities or their agencies. Munis typically will return a little more than Treasury bills while being just a bit riskier.

### Corporate Bonds

Corporate bonds are issued by companies. They carry more risk than government bonds because corporations can't raise taxes to pay for their bond issues. The risk and return of a corporate bond will depend on how creditworthy the company is. The highest-paying and highest-risk corporate bonds are often referred to as non-investment grade or, more commonly, **junk bonds**.

Corporate bonds that do not make regular coupon payments to their owners are referred to as **zero-coupon bonds**. These bonds are issued at a deep discount from their par values and will repay the full par value at their maturity date. The difference between what the investor spends on them in original purchase price and the par value paid at maturity will represent the investor's total dollar value return.

**Convertible bonds** are similar to other types of corporate bonds but have a feature that allows for their conversion into a predetermined number of common stock shares. The conversion from the bond to stock can be done at certain times during the bond's life, usually at the discretion of the bondholder.

## The Global Bond Market versus the Global Stock Market

Bonds have long been a trusted investment vehicle for many investors. Though the global fixed-income debt market remains considerably larger than the global stock market, this is not an entirely fair comparison. Bond markets include sovereign bonds, or bonds that are issues by governments, while stock markets do not. Some experts believe that a more relevant comparison is between the value of corporate bond markets only (excluding sovereign bonds) and total stock market value.

The chart in Figure 10.2 provides global market value information by category so that we may make our own conclusions about these markets.

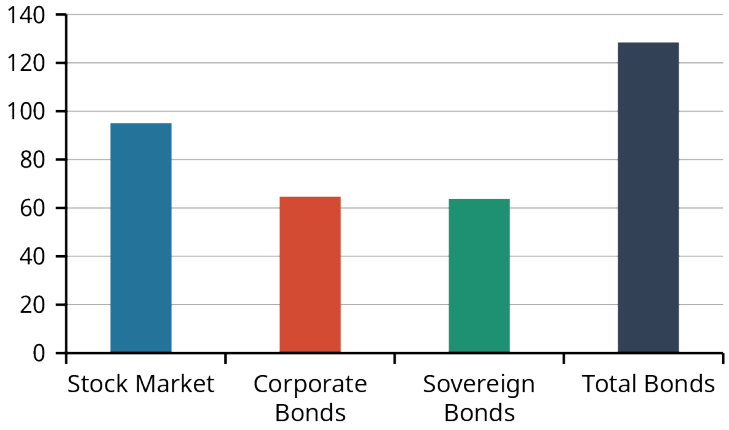


**Figure 10.2 Global Bonds versus Stocks: Total Market Values ($Trillions), November 2020** (data source: Nasdaq)

While the total value of bond markets continues to exceed that of stocks, the prevailing trend over the past several years has been that stock markets are gaining in terms of total market size. The primary reason for this is that stocks have traditionally outperformed bonds in terms of return on investment over extended periods of time and are likely to continue to do so. This makes them more attractive to investors, despite the higher risk associated with stock.

## The Two Sides of a Bond Investment

There are essentially two sides to a bond investment, meaning the bondholder will receive two types of cash inflow from the bond investment over its term. These are the payment of the par value at maturity (often referred to as payment of the face value of the bond at term end), and the periodic coupon payments (also called **interest income**) from the bond. These coupon payments are contractually determined and clearly indicated in the bond issue documentation received by the bondholder upon purchase.

As a result of these two types of inflow, bond valuation requires two different time value of money techniques—specifically, present value calculations—to be computed separately and then added together.

## The Relationship between Bond Prices and Interest Rates

**Bond price** and interest rate have an inverse relationship. When interest rates fall, bond prices rise, and vice versa (see Figure 10.3). If interest rates increase, the value of bonds sold at lower interest rates will decline. Similarly, if interest rates decline, the value of fixed-rate bonds will increase. An exception to this general rule is **floating-rate bonds** (often referred to as “floaters,” floating-rate notes, or FRNs).

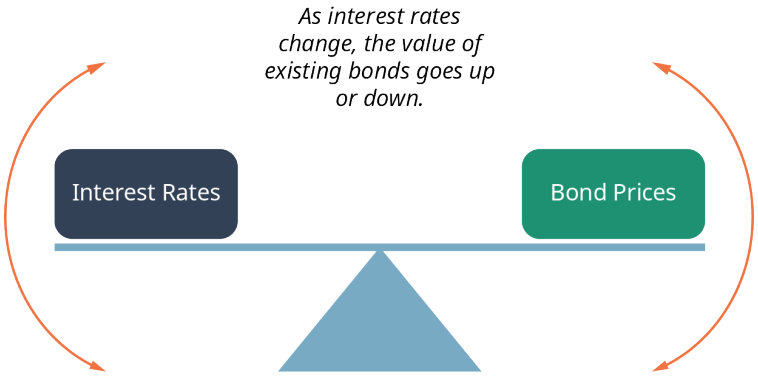


**Figure 10.3 The Seesaw Effect of Bond Prices and Interest Rates**

A floating-rate note is a form of debt instrument that is similar to a standard fixed-rate bond but has a variable interest rate. Rates for floating-rate bonds are typically tied to a benchmark interest rate that exists in the economy. Common benchmark rates include the **US Treasury note rate**, the **Federal Reserve funds rate (federal funds rate)**, the **London Interbank Offered Rate (LIBOR)**, and the **prime rate**.

So, investors who decide to purchase normal (fixed rate) bonds may not be thrilled to hear that the economy is signaling inflation and that interest rates are forecasted to rise. These bond investors are aware that when interest rates rise, their bond investments will lose value. This is not the case with floating- or variable-rate bonds.

Bonds with very low coupon rates are referred to as **deep discount bonds**. Of course, the bond that has the greatest discount is the zero-coupon bond, with a coupon rate of zero. The smaller the coupon rate, the greater the change in price when interest rates move.

LINK TO LEARNING

Relationship between Bond Prices and Interest Rates

Review this video (https://openstax.org/r/relationship-bond-prices) explaining the relationship between bond prices and interest rates within financial and capital markets.

# 10.2 Bond Valuation

## Learning Outcomes

By the end of this section, you will be able to:

- Determine the value (price) of a bond.
- Understand the characteristics of and differences between discount and premium bonds.
- Draw a timeline indicating bond cash flows.
- Differentiate between fixed-rate and variable-rate bonds.
- Determine bond yields.

## Pricing a Bond in Steps

Why do we want to learn how to price a bond? The answer goes to the heart of finance: the valuation of assets. We need to ascertain what a given bond is worth to a willing buyer and a willing seller. What is its value to these interested parties? Remember that a bond is a financial asset that a company sells to raise money from willing investors. Whether you are the company selling the bond or the investor buying the bond, you want to make sure that you are selling or buying at the best available price.

Let's begin our pricing examples with the 3M Company corporate bond listed in Table 10.1 above. The table

information tells us that 3M issued a series of corporate bonds that promise to pay coupons annually on September 19 and to pay back the principal, or face value, on the maturity date of September 19, 2026. While this is not specified in the table, let's say these are 15-year corporate bonds. In that case, we know that they were issued on September 20, 2011.

The 3M bonds have an annual coupon rate of 2.25%, which indicates that the annual interest payment on the bond will be the face value (assumed to be $1,000.00 multiplied by 2.25%), or $22.50. The appropriate discount rate to apply to these future payments is the yield to bond maturity, 1.24%.

Note that the 3M bond is selling at a premium (above par or face value) due to the fact that its coupon rate is greater than the YTM percentage. This means that the bond earns more value in interest than it loses due to discounting its cash flows to allow for the time value of money principle.

Finally, the table tells us some of the bond's features. For example, Standard & Poor's, an international rating agency, rates 3M Co. as A+ (high credit quality). Additionally, the bonds are designated as callable, meaning that 3M has the option of redeeming them before their maturity on September 19, 2026.

We can price a bond using the same methods from earlier chapters: an equation, a calculator, and a spreadsheet. Let's start with the equation method (see Figure 10.4).

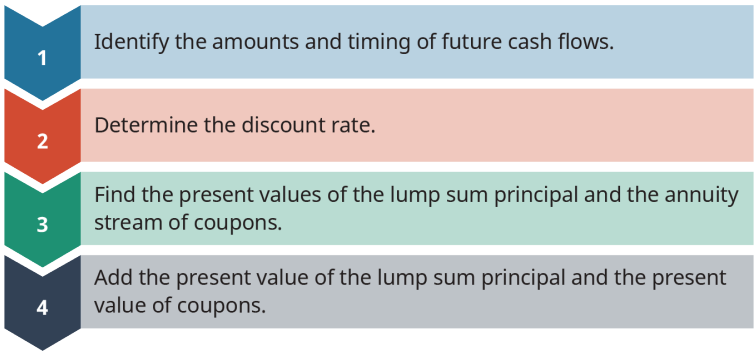


**Figure 10.4 Steps in Pricing a Bond**

The first step is to identify the amounts and the timing of the two types of future cash flows to be received on the bond. Any bond that pays interest or coupon payments (coupon bonds) will have two sources of future cash flow to its bondholder/investor: the periodic coupon payments, which are a form of annuity, and the final lump sum payment of the face value amount at maturity.

As discussed above, the principal or face value is paid in a one-time lump sum payment at bond maturity. In our example with 3M Co., this is the $1,000 par value of the bond that will be paid on the maturity date of September 19, 2026. Step 1 is to lay out the timing and amount of the future cash flows. The first future cash flow we need to determine is the annual interest payment. Here, it is the coupon rate of 2.25% times the par value of the bond. As mentioned above, we will use $1,000 as the par value of this bond, so the annual coupon or interest payment will equal $22.50:

$$\text{Par Value} \times \text{Annual Coupon Rate} = \text{Annual Coupon Payment} \quad \textbf{10.1}$$

$$\$1{,}000 \times 2.25\% = \$22.50 \quad \textbf{10.2}$$

The next future cash flow that we need to determine is the payment of the par value or principal—in this case, the $1,000 par value of the bond—at the maturity date of September 19, 2026. We can set out the future cash flows for the bond as shown in Table 10.2:

| Year (Period) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Coupons | $22.50 | $22.50 | $22.50 | $22.50 | $22.50 | $22.50 | $22.50 | $22.50 | $22.50 | $22.50 | $22.50 | $22.50 | $22.50 | $22.50 | $22.50 |
| Principal | | | | | | | | | | | | | | | $1,000 |

**Table 10.2**

Note that annual coupon payments are made each year on September 19, and the first annual coupon payment date is September 19, 2012. The annual payments continue for 15 years, with the last payment being made on September 19, 2026. At this point, we can apply previously learned concepts: the coupon payments constitute an annuity stream, or payments of the same amount at regular intervals.

The principal of $1,000 is also paid out at maturity. Here, we recognize another key concept: the final amount is a lump sum payment. So, we now have the promised set of future cash flows for the 3M Co. bond.

In Step 2, we will need to decide on a discount rate to use on these future bond cash payments. For now, we will jump to the answer and simply use the YTM of 1.24% from the bond data in Table 10.1. Later in the chapter, we will develop the concepts behind how an appropriate discount rate is determined.

For Step 3, we now apply two equations to the set of future cash flows from the bond. This will then provide us with the present values of these cash flows, or the expected present-day value of the bond. Because we know that the coupon payments constitute an annuity stream, we can use the equation for the present value of an annuity (discussed in Time Value of Money II: Equal Multiple Payments. To value the one-time par value payment, we use the equation for the present value of a lump sum payment. So, by combining these, we will have the present value of the coupon payment stream, or

$$\text{Coupon Payment Amount} \times \frac{\left[1 - \frac{1}{(1+r)^n}\right]}{r} = \text{PV}_{\text{Coupon}} \tag{10.3}$$

So, for our example above, this becomes

$$\begin{aligned} \$22.50 \times \frac{\left[1 - \frac{1}{(1+0.0124)^{15}}\right]}{0.0124} &= \text{PV}_{\text{Coupon}} \\ \$22.50 \times 13.61099 &\approx \$306.25 \end{aligned} \tag{10.4}$$

Next, we need to determine the present value of the payment of the par or face value of the bond at maturity. This is calculated as follows:

$$\text{Par Value} \times \frac{1}{(1+r)^n} = \text{PV}_{\text{Principal}} \tag{10.5}$$

Inserting our values into this formula gives us

$$\begin{aligned} \$1{,}000 \times \frac{1}{(1+0.0124)^{15}} &= \text{PV}_{\text{Principal}} \\ \$1{,}000 \times 0.831224 &\approx \$831.22 \end{aligned} \tag{10.6}$$

Adding the present values of the two payment streams gives us

$$\$306.25 + \$831.22 = \$1{,}137.47 \tag{10.7}$$

Our bond price is $1,137.47. This bond price represents the value of the financial asset to both a willing buyer and a willing seller.

In this example, the willing seller is 3M Company. The willing buyer is an investor who is demanding a 1.24% yield on the investment. As per Table 10.1 above, the 3M bond sold for $1,051.20 in March 2021. However, we display the price as a percentage of the par value, so we have the displayed price as

$$\frac{\$1{,}051.20}{\$1{,}000} = 1.05120 \text{ or } 105.120\% \quad \textbf{10.8}$$

Because we round the percent of par, we do not see the cents digit in the quoted price.

## Pricing a Bond Using a Financial Calculator

A financial calculator can also be used to solve common types of bond valuations. For example, what would be the current price (value) of a 4% coupon bond, paid semiannually, with a face value of $1,000 and a remaining term to maturity of 15 years, assuming a required YTM rate of 5%? The steps to solve this problem are shown in Table 10.3 below.

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 1 | Clear calculator register | CE/C | | 0.0000 |
| 2 | Enter future or par value as a negative amount | 1000 +\|− FV | FV = | -1,000.0000 |
| 3 | Enter interest rate $\left(\frac{5\% \text{ annual rate}}{2} = 2.5\% \text{ semiannual rate}\right)$ | 2.5 I/Y | I/Y = | 2.5000 |
| 4 | Enter periods Enter periods $(15 \text{ years} \times 2 = 30 \text{ semiannual periods})$ | 30 N | N = | 30.0000 |
| 5 | Enter coupon payment $\frac{\$1{,}000 \times 4\%}{2} = \$20$ as a negative amount | 20 +\|− PMT | PMT = | -20.0000 |
| 6 | Compute present value or price | CPT PV | PV = | 895.3485 |

**Table 10.3 Calculator Steps for Bond Valuations**[1]

The current price is $895.35.

## Time Value Connection

As we have briefly discussed, bond valuation is determined by time value of money techniques, most notably present value calculations. This makes logical sense when one considers that an investment in a bond involves a series of future cash inflows, or payments from the bond issuer to the bondholder over the term of the bond's maturity.

To determine the value of a bond today, the two-step time value of money calculation we discussed earlier must be used, and the present value of a series of coupon payments (or an annuity) must be determined. This present value amount will then be added to the present value of a single lump sum payment (the principal or face value) that will come to the bondholder at the end of the bond's term (maturity).

### Fixed Income

Because standard fixed-rate bonds have their coupon payments and maturity amounts locked in, they are often referred to as fixed-income investments. This is because their values are relatively straightforward to calculate. Bonds are generally viewed as stable investments that offer income and a lower amount of volatility compared to stocks.

1 The specific financial calculator in these examples is the Texas Instruments BA II Plus™ Professional model, but you can use other financial calculators for these types of calculations.

While yields provided by corporate and government bonds such as US T-bills and municipal bonds are currently low because the **Federal Reserve System (the Fed)** has kept interest rates low for several years, investors may still consider adding bonds to their portfolios.[2] This is especially true as investors enter their retirement years and seek to generate income while avoiding the volatility of the stock market. Such investors can add a mix of individual bonds, mutual funds, or exchange-traded funds to their portfolios, thus generating potential return while keeping risks at a minimum. Fixed-income investments such as intermediate- or longer-term bond funds are still providing good yields despite the low-interest-rate state of the economy.

It is important to note, however, that even though bonds are generally thought of as safer investments, they still are subject to a number of risks. Because income from most bonds is fixed, such instruments can have their values eroded by external factors such as interest rates and inflation. We will discuss some of these risks after the next section.

| Period | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| End Date | 6/30/20 | 12/31/20 | 6/30/21 | 12/31/21 | 6/30/22 | 12/31/22 | 6/30/23 | 12/31/23 | 6/30/24 | 12/31/24 |
| Coupon | $4,500 | $4,500 | $4,500 | $4,500 | $4,500 | $4,500 | $4,500 | $4,500 | $4,500 | $4,500 |
| Principal | | | | | | | | | | $100,000 |

**Table 10.4**

Table 10.4 shows the cash inflow of a five-year, 9%, $100,000 corporate bond dated January 1, 2020. The bond will have coupon (interest) payment dates of June 30 and December 31 for each of the following five years. Because the bond was issued on January 1, 2020, the year 2020 is the first full year of the bond, followed by the years 2021, 2022, 2023, and 2024, with the bond maturing in December of the latter year.

Cash inflows will be (1) the coupon or interest payments of $\frac{9\% \times \$100{,}000}{2} = \$4{,}500$, paid to the bondholder every six months, and (2) the one-time principal or face-value payment of $100,000 upon maturity on December 31, 2024.

## Yields and Coupon Rates

The two interest rates that we associate with a bond are often confusing to students when they first begin to work with bonds. The coupon rate is the interest rate printed on the bond; this is only used to determine the interest or coupon payments. The yield to maturity (YTM) is an interest rate that is used to discount the bond's future cash flow. The YTM is derived from the marketplace and is based on the riskiness of future cash flows.

As we have seen when pricing bonds, a bond's YTM is the rate of return that the bondholder will receive at the current price if the investor holds the bond to maturity.

### Yield to Maturity

As noted above, the market sets this discount rate, or the yield to maturity. The YTM reflects the going rate in the bond market for this type of bond and the bond issuer's perceived ability to make the future payments. Hence, we base the yield on a mutually agreeable price between seller and buyer. The bond market determines the YTM and the available supply of competing financial assets. By competing against other available financial assets, the YTM reflects the risk-free rate and inflation, plus such premiums as maturity and default specific to the issued bond.

The YTM is the expected return rate on the bond held to maturity. How do we determine the bond's YTM? We can use our same three trusty methods: equations, a financial calculator, and Microsoft Excel (as shown at the end of the chapter).

2 Adam Hayes. "What Do Constantly Low Bond Yields Mean for the Stock Market?" *Investopedia*. June 15, 2021. https://www.investopedia.com/ask/answers/061715/how-can-bond-yield-influence-stock-market.asp

## Determining Bond Yield Using an Equation

The solution, when solving for discount rates, requires us to revisit the bond pricing formula, which is

$$\text{Bond Price} = \text{Par Value} \times \frac{1}{(1+r)^n} + \text{Coupon Payment Amount} \times \frac{\left[1 - \frac{1}{(1+r)^n}\right]}{r} \quad \textbf{10.9}$$

Of course, with one equation, we can solve for only one unknown, and here the variable of concern is *r*, which is the YTM. Unfortunately, it is difficult to isolate *r* on the left-hand side of the equation. Therefore, we need to use a calculator or spreadsheet to solve for the bond's YTM.

Let's take another bond, the Coca-Cola bond, from Table 10.1 above and again back up our time to March 2021. If the Coca-Cola bond has just been issued in March 2021, then it would be a seven-year, semiannual bond with a coupon rate of 1.0% and an original price of $952.06 at the time of issue (Table 10.5).

| Bond Characteristic | Details |
|---|---|
| Price (% of par) | 95.20 |
| Coupon rate | 1% |
| Maturity date | March 15, 2028 |
| Standard & Poor's Rating | A+ |
| Coupon payment frequency | Semiannual |
| First coupon date | September 1, 2021 |
| Type | Corporate |
| Callable? | Yes |

**Table 10.5 Overview of Coca-Cola Bond (as of March 2021)** (credit: FINRA-Markets.Morningstar)

## Determining Bond Yield Using a Calculator

For the Coca-Cola bond above, what was the bond's YTM at its issue date? This is not an easy problem to solve with a mathematical formula. It is far more practical, not to mention easier, to use a financial calculator or an Excel spreadsheet to solve for bond prices, yields, and maturity periods.

We will cover Excel applications later, but we can jump into some calculator examples right now. So, to calculate the yield on the Coca-Cola bond, we'll start by entering the values we have for this bond into a calculator. The values we know are as follows:

$$\$1{,}000 \text{ par value} \quad \textbf{10.10}$$

$$14 \text{ payments } (n = 7 \text{ years} \times 2 \text{ payments per year}) \quad \textbf{10.11}$$

$$\$5.00 \text{ coupon per period} \left(\frac{\$1{,}000 \times 1\%}{2} = \$5.00\right) \quad \textbf{10.12}$$

If the bond's selling price was $952.06 at issue, we have all the information we need to determine the bond's YTM at issue. Table 10.6 shows the steps for using a calculator to come to an answer.

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 1 | Clear calculator register | CE/C | | 0.0000 |
| 2 | Enter present value or price as a negative amount | 952.06 +\|− PV | PV = | -952.0600 |
| 3 | Enter future or par value | 1000 FV | FV = | 1,000.0000 |

**Table 10.6 Calculator Steps for Bond's Yield to Maturity at Issue**

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 4 | Enter periods $7 \text{ years} \times 2 = 14 \text{ semiannual periods}$ | 14 N | N = | 14.0000 |
| 5 | Enter coupon payment $\left(\frac{\$1{,}000 \times 1\%}{2} = \$5.00\right)$ | 5 PMT | PMT = | 5.0000 |
| 6 | Compute interest rate | CPT I/Y | I/Y = | 0.8651 |

**Table 10.6 Calculator Steps for Bond's Yield to Maturity at Issue**

The calculated I/Y (interest rate or YTM) of 0.8651 is a semiannual figure because the periods and coupon payments we entered for the calculation are semiannual values. To covert the semiannual value into an annual rate, we will need multiply the calculated I/Y by 2. This gives us an amount of 1.73%.

So, the YTM of the Coca-Cola bond at issue date was 1.73%. It is important to know that unless otherwise indicated, bond yields are expressed in annual percentage terms.

We have just demonstrated how a calculator can be used to determine the YTM or interest rate of a bond. Let's look at a few more examples that cover the most common types of bond problems. These are determining a YTM, calculating a bond's current price (or value), and determining a bond's maturity period.

First, let's work through another example of calculating a YTM, but this time with a bond that has annual interest payments instead of semiannual coupons.

Let's say you are considering buying a bond, but you want to calculate the YTM to determine if it will meet your overall return requirements. Some facts you have on the bond are that it has a $1,000 face value and that it matures in 12 years. Assume that the current price of the bond is $675 and it pays coupons annually at 3.5%. See Table 10.7 for the steps to calculate the YTM.

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 1 | Clear calculator register | CE/C | | 0.0000 |
| 2 | Enter present value or price as a negative amount | 675 +\|− PV | PV = | -675.0000 |
| 3 | Enter future or par value | 1000 FV | FV = | 1,000.0000 |
| 4 | Enter periods (12 years) | 12 N | N = | 12.0000 |
| 5 | Enter coupon payment $(\$1{,}000 \times 3.5\% = \$35.00)$ | 35 PMT | PMT = | 35.0000 |
| 6 | Compute interest rate | CPT I/Y | I/Y = | 7.7589 |

**Table 10.7 Calculator Steps for Computing Yield to Maturity**

By following the steps in the table above, you will arrive at a YTM of 7.76%.

Using a calculator is fast and accurate for finding bond yields. Thus, if you know the bond's current price and all of the future cash flows, you can find the YTM, or the return rate that the bond buyer is receiving on the funds loaned to the bond issuer. As mentioned, Excel spreadsheets are as easy and accurate as a financial calculator for determining bond rates, and we will cover these later in the chapter.

## Determining Bond Price or Value Using a Calculator

Let's say a friend recommends a 20-year bond that has a face value of $1,000 and a 6% annual coupon rate. If similar bonds are yielding 4% annually, what would be a fair price for this bond today? Table 10.8 shows the steps to make this determination.

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 1 | Clear calculator register | CE/C | | 0.0000 |
| 2 | Enter future or par value as a negative amount | 1000 +\|− FV | FV = | -1,000.0000 |
| 3 | Enter interest rate (4% annual rate) | 4 I/Y | I/Y = | 4.0000 |
| 4 | Enter periods (20 years) | 20 N | N = | 20.0000 |
| 5 | Enter coupon payment ($\$1{,}000 \times 6\% = \$60$) as a negative amount | 60 +\|− PMT | PMT = | -60.0000 |
| 6 | Compute present value or price | CPT PV | PV = | 1,271.8065 |

**Table 10.8 Calculator Steps for Computing Present Value**

So, the bond should be priced today at $1,271.81.

## Determining Bond Maturity Using a Calculator

Imagine you are considering investing in a bond that is selling for $820, has a face value of $1,000, and has an annual coupon rate of 3%. If the YTM is 10%, how long would it take for the bond to mature? See Table 10.9 for the steps to calculate the time to maturity.

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 1 | Clear calculator register | CE/C | | 0.0000 |
| 2 | Enter present value or price as a negative amount | 820 +\|− PV | PV = | -820.0000 |
| 3 | Enter interest rate (10% annual rate) | 10 I/Y | I/Y = | 10.0000 |
| 4 | Enter future or par value | 1000 FV | FV = | 1,000.0000 |
| 5 | Enter coupon payment ($\$1{,}000 \times 3\% = \$30.00$) | 30 PMT | PMT = | 30.0000 |
| 6 | Compute periods until maturity | CPT N | N = | 3.1188 |

**Table 10.9 Calculator Steps for Computing Time to Maturity**

So, the bond's time to maturity would be 3.12 years.

### THINK IT THROUGH

#### Using a Calculator

If a $1,000 face value bond is selling for $595, has 20 years until it matures, and has a YTM of 6.5%, what are the coupon rate and the periodic coupon payment of the bond? Follow the steps in Table 10.10.

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 1 | Clear calculator register | CE/C | | 0.0000 |
| 2 | Enter present value or price as a negative amount | 595 +\|− PV | PV = | -595.0000 |
| 3 | Enter periods | 20 N | N = | 20.0000 |
| 4 | Enter future or par value | 1000 FV | FV = | 1,000.0000 |

**Table 10.10 Calculator Steps for Computing Coupon Payment**

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 5 | Enter interest rate or YTM | 6.5 I/Y | I/Y = | 6.5000 |
| 6 | Compute coupon payment | CPT PMT | PMT = | 28.2437 |

**Table 10.10 Calculator Steps for Computing Coupon Payment**

**Solution:**

The annual coupon payment amount is \$28.24. This means the coupon rate on the bond is $\frac{28.24}{1{,}000} = 2.824\%$.

### The Coupon Rate

The coupon rate is the rate that we use to determine the amount of a bond's coupon payments. The issuer states the rate as an annual rate, even though payments may be made more frequently. Thus, for semiannual bonds, the most common type of corporate and government bond, the coupon payment is the par value of the bond multiplied by the annual coupon rate and then divided by the number of payments per year, 2.

We have already seen the coupon rate. The first bond we reviewed, the 3M Co. bond, was an annual coupon bond with a coupon rate of 2.25%. Using a par value of \$1,000, we determined that the annual coupon payments would be $\$1{,}000 \times 0.0225 = \$22.50$.

For the Coca-Cola bond, we note from Table 10.5 that it has a coupon rate of 1% and is paid semiannually. Using a par value of \$1,000, we can determine that the coupon payments would be $\frac{\$1{,}000 \times 1\%}{2} = \$5.00$.

## The Relationship of Yield to Maturity and Coupon Rate to Bond Prices

The value or price of any bond has a direct relationship with the YTM and the coupon rate.

- When the coupon rate of a bond exceeds the YTM, the bond sells at a premium compared to its par value. That is, market demand will push the price of the bond to an amount greater that than its face or par value. We call this kind of bond a **premium bond**.
- When the coupon rate is less than the YTM, the bond sells at a discounted amount, or less than its par value. We refer to such a bond as a **discount bond**.
- When the coupon rate and YTM are identical, a bond will sell at its par value. Bonds that experience this scenario in the market are referred to as par value bonds.

The interest or coupon payments of a bond are determined by its coupon rate and are calculated by multiplying the face value of the bond by this coupon rate.

The inverse relationship of interest rates and bond prices is an important concept for investors to know. Because interest rates fluctuate and can change significantly over time, it is important to understand how these changes will impact bond values.

# 10.3 Using the Yield Curve

### Learning Outcomes

By the end of this section, you will be able to:

- Use the yield curve to show the term structure of interest rates.
- Describe and define changes in the yield curve shape.
- Explain the importance of the yield curve shape.

## Term Structure of Interest Rates

The expected yields of various bonds across different maturity periods are referred to as the *term structure of interest rates*. This is because they represent interest rates for different periods of time, maturities, or terms.

When interest rate yields are plotted against their respective maturity periods and these plotted points are connected, the resulting line is called a **yield curve**. Essentially, the yield curve is a result of this plotting process and becomes a graphical representation of the term structure of interest rates. A yield curve will always be constructed by showing the value of yields (rates) on the *y*-axis and maturities or time periods on the *x*-axis (see Figure 10.5).

To create a useful graph of the yield curve, interest rate yields should be computed for all government bonds at all remaining times to maturity. For example, the yields on all government bonds with a single year remaining until maturity should be calculated. This value is then plotted on the *y*-axis against the one-year term on the *x*-axis. Similarly, yields on government bonds with two years remaining until maturity are calculated and plotted on the *y*-axis against two years on the *x*-axis, and so on, until a point of critical mass of information is reached and the resulting graph displays useful information.

The yield curve for government bonds is also known as the *risk-free yield curve* because these securities are thought of as safe investments that are not expected to fail or default and will in all likelihood repay or otherwise meet all financial obligations made through the bond issuance.

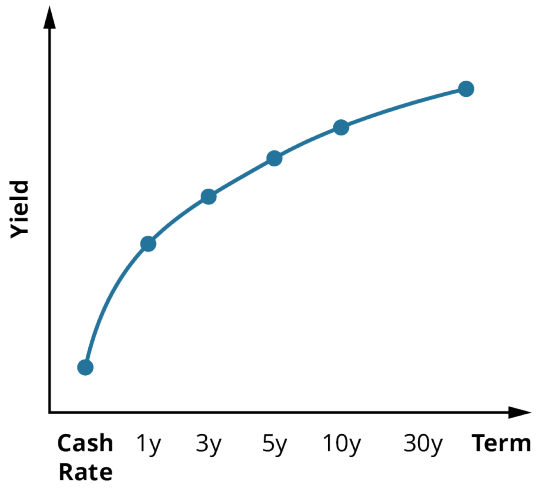


**Figure 10.5 A Normal Yield Curve: Long-Term Rates Are Higher Than Short-Term Rates**

A normal yield curve slopes upward, with yield increasing as the term increases. This is because yields on fixed-income investments such as bonds will rise as maturity periods increase and produce greater levels of risk.

Corporate issuers of bonds will usually offer bond issues at higher yields that the government, which is understandable because they are potentially riskier for investors. Government securities are guaranteed by governments and have little to no chance of default or nonpayment. This is not the case for corporate bonds, where there is always a chance of default, though the likelihood of this occurring will vary by individual company or issuer as well as by bond type and term. We will discuss bond default and default risk next.

### LINK TO LEARNING

#### The Yield Curve

Review this video (https://openstax.org/r/introduction-to-the-yield-curve) that introduces the concept of the yield curve.

## Different Shapes of the Yield Curve

There are two important elements to any yield curve that will define its shape: its level and its slope. The level of a yield curve directly relates to the yield rates depicted on the *y*-axis of the graph (see Figure 10.6). The slope of the yield curve indicates the difference between yields on short-term and longer-term investments. The difference in yields is primarily due to investors' expectations of the direction of interest rates in the economy and how the federal funds rate (referred to as **cash rate** in many countries) is uncertain and may differ significantly over time. As an example, yields on three-year bonds incorporate the expectations of investors on how bank rates might move over the next three years, combined with the uncertainty of those rates over the three-year period.

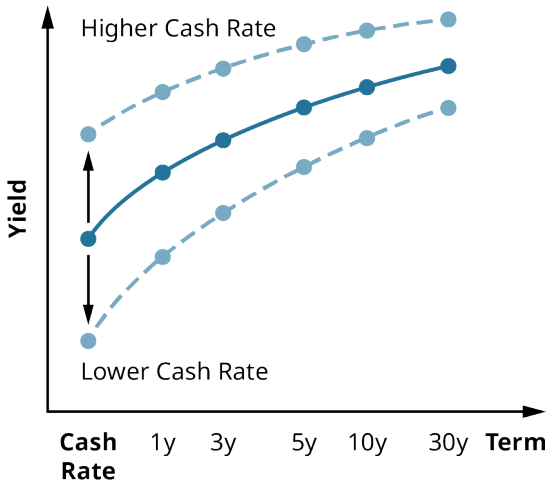


**Figure 10.6 Changes in Yield Curve Depending on Cash Rate**

As we briefly discussed above, a positive or normal yield curve is indicative of the investment community's requirements for higher rates of return as financial consideration for assuming the risk of entering into fixed-income investments, such as the purchase of bond issues. Typically, as a bond term increases, so will the potential interest rate risk to the bondholder. Therefore, bonds with longer terms will usually carry higher coupon rates to make returns greater for investors. Additionally, economists have come to believe that a steep positive yield curve is a sign that investors anticipate relatively high inflation in the future and thus higher interest rates accompanied by higher investment yields over shorter (inflationary) periods of time.

Normal yield curves are generally observed during periods of economic expansion, when growth and inflation are increasing. In any expansionary economy, there is a greater likelihood that future interest rates will be higher than current rates. This tends to occur because investors will anticipate the Fed or the central bank raising its short-term rates in response to higher inflation rates within the economy.

### CONCEPTS IN PRACTICE

#### How COVID-19 Impacted the Yield Curve

Figure 10.7 shows the relatively normal-shaped yield curve effective in February 2021.

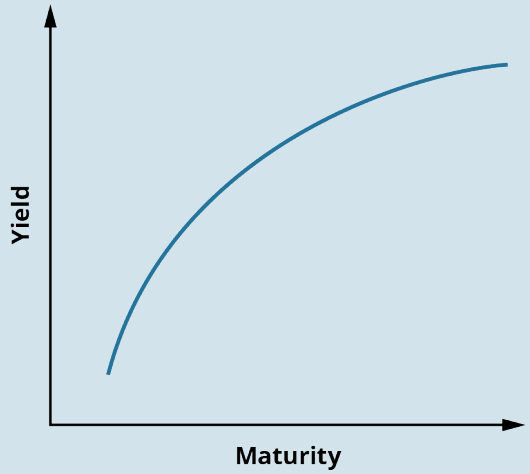


**Figure 10.7 Yield Curve in February 2021**

A yield curve with an inverted (downward-sloping) shape is considered unusual and will occur when long-term rates are lower than short-term rates. This causes the yield curve to assume an inverted shape with a negative slope. An inverted yield curve has historically been observed as a prelude to a general decline in economic activity and interest rate levels. In some countries, such as the United States, an inverted yield curve has been associated with upcoming recession and economic contraction.

This may occur because central banks, such as the Federal Reserve in the United States, will often attempt to stimulate a stagnant economy by reducing interest rates. Essentially, the potential actions of the central bank to improve the economy have the effect of lowering overall money rates with the economy, which is exactly what investors anticipated would happen and why the yield curve was inverted to begin with.

The yield curve was considered normal with an upward slope in August 2018, as shown in Figure 10.8, but the curve inverted in March 2019 as yields on short-term bonds exceeded those of longer-term bonds, resulting in concerns surrounding impending recession and other economic problems. This inverted shape to the yield curve continued into 2020, as evidenced in Figure 10.9.

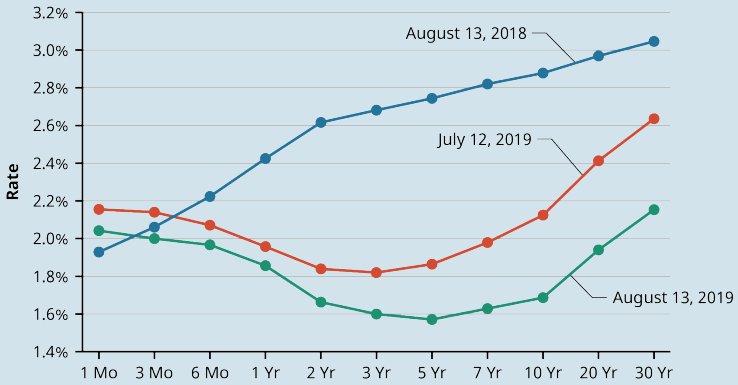


**Figure 10.8 The Economy Shifts to an Inverted Yield Curve** (data source: US Department of the Treasury, Resource Center, Daily Treasury Yield Curve Rates)

Yield curves constructed on different days in early 2020 appeared similar to the examples below. Again, these are obviously not normal yield structures. As a specific example, note on the February 21, 2020, curve that rates on five-year securities are lower than those of one-year and even three-month securities.

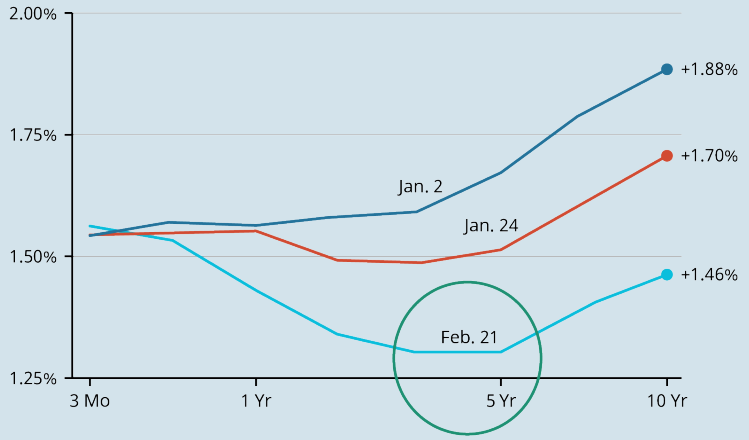


**Figure 10.9 Elements of Inversion in Recent Yield Curves** (data source: US Department of the Treasury, Resource Center, Daily Treasury Yield Curve Rates)

This inverted yield curve signaled the beginning of a recessionary period in the United States, which was compounded by the COVID-19 pandemic and the closing of many restaurants and businesses.

In March and April 2020, the US economy experienced a significant decline. Most economic indicators dropped so badly that the National Bureau of Economic Research's **Business Cycle Dating Committee**, the US agency that officially declares recessions, was required to intervene.[3]

The recession declaration process by the committee is completed over the course of four months, but in this instance, it only took a total of 15 weeks for the committee to make its declaration. This remains the fastest declaration by the committee on record since the founding of the National Bureau of Economic Research (NBER) in 1978.[4]

In July 2021, the committee declared that the economy had reached a trough in April 2020, marking the end of the recession of the early 2020s and making it the shortest US recession on record as well as the most quickly identified one.[5]

(sources: www.nytimes.com/2019/11/08/business/yield-curve-recession-indicator.html; www.nber.org/news/business-cycle-dating-committee-announcement-june-8-2020; fredblog.stlouisfed.org/2020/11/are-we-still-in-a-recession/)

A flat shape for the yield curve occurs when there is not a great deal of difference between short-term and long-term yields (see Figure 10.10). A flat curve is usually not long lasting and is often observed when the curve is transitioning between a normal and an inverted shape, or vice versa.

A flat yield curve has also been observed as a result of low interest rate levels or some types of unconventional monetary policy.

3 National Bureau of Economic Research. "Business Cycle Dating Committee Announcement June 8, 2020." *NBER News.*
4 Jeffrey Frankel. "The US Is Officially in Recession Thanks to the Corona Virus Crisis." *The Belfer Center for Science and International Affairs.* Harvard Kennedy School, June 16, 2020. https://www.belfercenter.org/publication/us-officially-recession-thanks-corona-virus-crisis
5 National Bureau of Economic Research. "Business Cycle Dating Committee Announcement July 19, 2021." *NBER News.* July 19, 2021. https://www.nber.org/news/business-cycle-dating-committee-announcement-july-19-2021

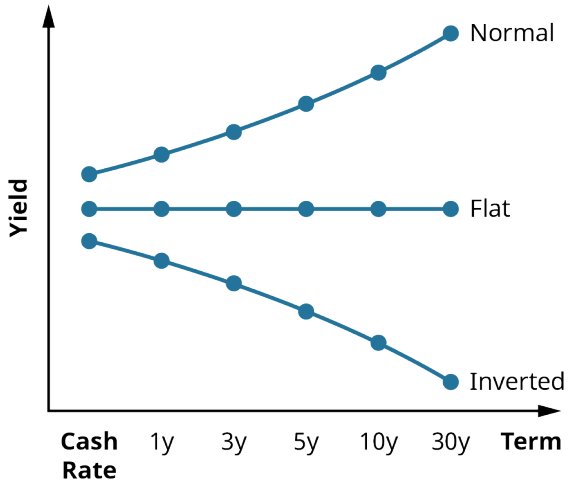


**Figure 10.10 Graph Depicting Normal, Flat, and Inverted Yield Curves**

## Why Is the Yield Curve Important?

Market technicians, brokers, and investment analysts will study the yield curve in great detail by keeping track of its many changes and movements. This is because of the overall importance of the yield curve as an economic indicator and how it can be representative of the ideas, attitudes, and bond market expectations of individuals as well as large institutional investors that exert significant influence on investment markets and the economy as a whole.

# 10.4 Risks of Interest Rates and Default

### Learning Outcomes

By the end of this section, you will be able to:

- Define interest rate, default, and other common forms of bond risk.
- Calculate the primary indicator of interest rate risk.
- Determine factors impacting default risk.
- Understand bond laddering as an investment strategy.
- List major rating agencies and their indications of default.
- Define and calculate the yield to maturity (YTM) on a bond.

## Bond Risks

As we touched on earlier, bonds are fixed-income investments, and because of this, they are subject to a number of risks that could have negative effects on their market value. The most common and best-known risks are **interest rate risk** and **default risk**, but other risks exist that should be understood. Among these risks are the following:

- **Credit risk**. If investors believe that a bond issuer is unlikely to meet its payment commitments, they may demand a higher yield to purchase the bond issue in the first place. Due to the relative stability of governments compared to corporations, government bonds are considered to have low credit risk.
- **Liquidity risk**. If investors believe that a bond may be difficult to sell, it will likely have a higher yield. This has the effect of compensating the bondholder for the lack of liquidity (the ability to cash out of the bond). Government bonds usually have the lowest yields of all investments available and are typically among the most liquid in any country where they are traded. Government securities will only face significant liquidity risk in times of great economic distress.
- **Duration risk**. Duration risk is the risk associated with the sensitivity of a bond's price to a single 1% change in interest rates. A bond's **duration** is expressed in numerical measurements. The higher the duration number, the more sensitive a bond investment will be to changes in interest rates.

- **Call risk and reinvestment risk. Call risk** is the risk of bonds being redeemed or called by the issuing firm before their maturity dates. Corporations may elect to call a bond issue (provided the bond issue has a call feature) when interest rates drop and companies are in a position to save a great deal of money by issuing new bonds with lower coupon rates. To investors, this is a risk in and of itself, but call risk also has the effect of potentially causing reinvestment risk. **Reinvestment risk** is defined as the risk to investors when they find themselves facing unfavorable alternatives for investing the proceeds from their called bonds in new, lower-paying investments. This can potentially lead to substantial financial loss for the original bond investors.
- **Term risk**. Investors will generally demand higher returns for lending funds at fixed interest rates. This is because doing so exposes them to the risks presented by rising interest rates and the negative impact of these higher rates on their bond holdings. In a scenario of rising interest rates, investors will find that their return from lending money through a bond purchase just once, at a fixed interest rate, will be lower than the return they might have realized from making several different investments for much shorter periods of time. Term risk is usually measured by a special indicator referred to as the *term premium*.

As mentioned above, however, the most common forms of bond risk are interest rate risk and default risk.

### Interest Rate Risk

As we have discussed, when interest rates rise, bond values will fall. This is the general concept behind interest rate risk. Any investor in **fixed-income securities** (such as bonds) will have to contend with interest rate risk at one time or another. Interest rate risk is also referred to as *market risk* and usually increases the longer an investor maintains a bond investment.

### Default Risk

Any time a bond is purchased, the investor is taking a risk that the bond issuer may be late in making scheduled payments on a bond issue—or, in the worst case, may not be able to make payments at all. This is the underlying idea behind the concept of default risk.

Because US Treasury securities have the full backing of the government, they are generally considered free of default risk. However, most corporate bonds will face some possibility of default. Obviously, some bonds and their issuing companies are riskier in this respect than others.

To assist potential bond investors in understanding some of these risks, **bond ratings** are regularly published by a number of organizations to express their assessment of the risk quality of various bond issues. We will discuss these bond ratings and the companies that issue them next.

## Bond Ratings and Rating Providers

It is important for investors to know the risks they are assuming when investing in bonds. Many investors will take advantage of information provided by bond rating services to assess the likelihood of borrowers (bond issuers) defaulting on the financial obligations of their bond issues.

To help investors evaluate the default risks of bonds, **rating agencies (bond rating services)** were established to evaluate bonds and other fixed-income investments, taking into consideration and then analyzing any information that has been published or otherwise made available to the investing public. These services then apply a rating system that has been developed for measuring the quality of bonds and assign individual grades to each bond and its issuing company.

The three largest and best-known bond rating providers are Fitch Ratings, Moody's Investors Service, and Standard & Poor's (S&P) Global Ratings. The rating system used by these services identifies the very highest-quality bonds (the least likely to default) as triple-A (AAA or Aaa), followed next in quality level by double-A bonds (AA or Aa), and so on. Any bond that is rated BBB (S&P, Fitch) / Baa (Moody's) or higher is referred to as **investment grade** and is considered strong and stable by the investment community (see Table 10.11).

It is important to note that investment-grade bonds are among the most popular due to the fact that many commercial banks, as well as several pension funds, are only allowed to trade bonds that are investment grade.

Any bond that is below investment grade, or rated lower than BBB (S&P, Fitch) or Baa (Moody's), is referred to as a high-yield bond or a junk bond. Junk bonds have had mixed levels of success for companies wishing to issue them to raise capital. In the early 1990s, the market for junk bonds collapsed, due in part to a political movement involving influential people who had been dominating corporate debt markets. This movement, combined with illegal insider trading activities conducted by investments banks, ultimately resulted in the bankruptcy of former financial giant Drexel Burnham Lambert.[6]

| S&P / Fitch | Moody's | Grade | Meaning |
|---|---|---|---|
| AAA | Aaa | Investment | Risk almost zero |
| AA | Aa | Investment | Low risk |
| A | A | Investment | Risky if economy declines |
| BBB | Baa | Investment | Some risk; more if economy declines |
| BB | Ba | Speculative | Risky |
| B | B | Speculative | Risky; expected to get worse |
| CCC | Caa | Speculative | Probably bankruptcy |
| CC | Ca | Speculative | Probably bankruptcy |
| C | C | Speculative | In bankruptcy or default |
| D | | Speculative | In bankruptcy or default |

**Table 10.11 Bond Ratings** (sources: S&P Global Ratings; Moody's)

The market for junk bonds enjoyed a brief resurgence in popularity when the economy improved later in the 1990s. However, in 2001, the junk bond market shrank once again, resulting in 11% of US junk bond issues defaulting.

In general, it is important to understand that bond ratings are only judgments on corporations' future ability to repay debt obligation and their growth prospects. There is no fixed methodology or basis for calculating a bond rating. However, some financial analysts can get a strong indication of how a bond will be rated by examining certain financial ratios of the issuing firm, such as company debt ratio, earnings-to-interest ratio, and their return on assets.

## CONCEPTS IN PRACTICE

### The Collapse of Enron: Bond and Credit Ratings and How They Change

The bond rating system is not infallible. A perfect example of this is when energy giant Enron failed in 2001. After the collapse, investors correctly pointed out that a mere two months before this occurred, the company's bonds were rated as investment grade and considered relatively safe, having little risk for investors.

**Background on Enron**

From its formation in 1985 through the late 1990s, Enron grew to become an energy mega-conglomerate, expanding into areas such as trading of futures contracts, paper products, electricity, water, pipelines, and

6 Lawrence Delevingne. "The Drexel Collapse, 25 Years Later." *CNBC*. February 13, 2015. https://www.cnbc.com/2015/02/13/the-drexel-collpase-25-years-later.html

broadband services. Reported revenues grew at an exceptional pace, Enron's stock price continued to rise, and business was proceeding exceptionally well.

However, things were not as they appeared on the surface. Enron's financial statements were often very confusing to shareholders and analysts. Additionally, Enron's unscrupulous business practices included revenue misstatements and other questionable accounting practices to indicate favorable financial performance. On top of this, some of Enron's speculative business ventures proved to be disastrous, resulting in substantial financial losses.

Initial allegations against Enron also focused on the role of their public accountants, Arthur Andersen. Andersen was one of the Big Five accounting firms in the United States at that time and had served as Enron's auditing firm for over 16 years. According to court documents, Enron and Arthur Andersen had improperly categorized hundreds of millions of dollars of transactions as increases to the company's shareholder equity. It was also later discovered that Andersen failed to follow generally accepted accounting principles (GAAP) when considering Enron's dealings with related partnerships. As a result, Enron was able to conceal some of its losses from the investing public. After investigation by the United States Justice Department, the firm was indicted on obstruction of justice charges in March 2002. The combination of all of these irregularities and issues resulted in the December 2, 2001, bankruptcy of the corporation.[7] It was later determined that the majority of these unethical issues had been perpetuated with the indirect knowledge or even, in some cases, by the direct actions of the board of directors or senior operational management of the company.

**Specifics and Enron's Bond Ratings**

On October 27, 2001, the company began buying back all its commercial paper, valued at around $3.3 billion, in an effort to calm investor fears about Enron's supply of cash. On November 8, Enron announced that restatements to its financial statements for the years 1997–2000 were necessary to correct several accounting violations. However, by November 28, 2001, credit rating agencies had reduced Enron's bond rating to junk status.[8]

**Other Examples of Significant Bond Ratings Downgrades**

Some companies that have recently experienced downgrades (or potential downgrades) to their credit and bond ratings include Delta Airlines, Ford, Occidental Petroleum, Carnival Cruises, and T-Mobil. Some of these businesses, such as Delta and Carnival, are suffering the effects of the COVID-19 pandemic, but the hope is that they don't experience the same disastrous fate as Enron.

(sources: www.britannica.com/event/Enron-scandal; www.journalofaccountancy.com/issues/2002/apr/theriseandfallofenron.html; corporatefinanceinstitute.com/resources/knowledge/other/enron-scandal/; www.wsj.com/articles/corporate-bond-downgrades-grow-as-coronavirus-spreads-11585849497)

## Concepts of Bond Returns

Bond investors earn profits through two different means: collecting interest income and generating **capital gains**. These are important concepts for any investor who considers putting their money in fixed-income securities such as bonds.

### Collecting Interest Income

As we have covered, when investors buy bonds, they are lending money to bond issuers. The coupon rate of a

7 Douglas O. Linder. "Enron (Lay & Skilling) Trial (2006)." *Famous Trials*. Accessed November 24, 2021. https://famous-trials.com/enron

8 Paul M. Healy and Krishna G. Palepu. "The Fall of Enron." *Journal of Economic Perspectives* 17, no. 2 (Spring 2003): 3–26. https://doi.org/10.1257/089533003765888403

bond is determined by the issuer and is generally tied to the overall level of interest rates in the economy at the time of issue as well as the maturity period of the bond and the credit rating of the issuer. The established coupon rate then governs how much periodic interest is paid to bondholders. For example, if an investor purchases a 5%, $1,000 bond with a 20-year maturity and annual coupon payments, that investor will receive 20 coupon payments equal to $\$1{,}000 \times 5\%$ or $20 \times \$50$ for a total of $1,000.

Depending on interest and inflation rates over the 20-year period, this could be a very favorable situation resulting in significant **realized return** for the investor. However, if interest rates and inflation over the investment period are at high levels, the investment is not nearly as attractive.

### Generating Capital Gains

Many bonds are not held until their maturity dates. Should an investor require funds before maturity, they have the option to sell them through a broker in the secondary market. When this situation occurs, the investor may earn a capital gain or experience a capital loss, depending on whether the bond ends up being sold at a premium (above face value) or at a discount (below face value).

For example, if an investor bought a corporate bond yielding 7% and then the economy changed so that comparable bonds yielded 10%, the investor would have to lower their price on the original 7% bond until it also yielded the 10% market rate. Potential investors would not be very likely to buy the bond if they could simply buy a newly issued bond from an alternate issuer and receive a higher coupon rate.

It is equally possible that prevailing bond rates could fall and an investor could end up selling their bond at a higher price, thus earning a capital gain.

## Bond Laddering as an Investment Strategy

There are several successful strategies for successful bond investments, but perhaps one of the most common yet ingenious of these strategies is called *bond laddering*. Bond ladders help investors achieve diversity in their portfolios and reduce risk while helping maintain regular cash inflows in the form of coupon payments or interest. In a bond ladder, an investor will divide their total investment dollars among various bonds that mature at regular intervals, thereby balancing risk and return. An example of a bond ladder would be to purchase 10 different bonds that have maturities of one year, two years, three years, and so on, all the way through to 10 years.

When the first bond matures, the investor will purchase a new bond that matures in 10 years to take its place in the ladder and continue the overall laddering strategy.

This strategy has several benefits. First, the shorter-term bonds in the ladder provide stability because they are less sensitive to risk than longer-term bonds. The longer-term bonds within the ladder will generally provide higher returns but with higher risk due to such factors as rising interest rates. So, by investing in bonds with different maturities and creating a bond ladder, investors can realize superior financial returns to what they would earn by only investing in short-term bonds. Also, the general level of risk from a bond ladder is reduced by the shorter-term component of the investment mix, making the bond ladder less risky than an investment that only included long-term bonds.

It is easy to see why bond laddering has become such a highly adopted bond investment strategy with investors ranging from novice to the most well-seasoned and experienced.

## Interest Rate Movements and Bond Prices

We now know that when investors buy bonds, either directly or through mutual funds, they are lending money to bond-issuing firms or governments. In turn, issuers promise to pay back the principal (par or face value) when the loan is due at the bond's maturity date.

Issuers also promise to pay bondholders periodic interest or coupon payments to compensate them for the use of their money over the term of the bond. The rate at which issuers pay investors, or the bond's stated

coupon rate, is typically fixed at the time of issuance.

We have also covered the concept that bond values have an inverse relationship with interest rates. As interest rates rise, bond prices fall, and when interest rates fall, bond values increase. Movement of interest rates can have a dramatic effect on a bond's value and presents the typical bondholder with a number of different financial risks that we have described in detail.

Also in this chapter, we have discussed how bond values can be estimated through the use of several different factors. Prevailing interest rates are among the most critical of these, but also important are factors such as maturity periods, the taxability of bond interest, the credit standing of bond issuers, and the likelihood of **bond call**, or issuers paying off their debt early.

When considering purchasing bonds or any such fixed-income investment, investors should remain aware that interest rates are always in a state of flux and can change at any time. The movements of bond values and bond yields will be significantly affected by these changes and can be favorable or unfavorable for any investor.

# 10.5 Using Spreadsheets to Solve Bond Problems

## Learning Outcomes

By the end of this section, you will be able to:

- Demonstrate bond valuations using Excel.
- Demonstrate bond yield calculations using Excel.

## Calculating the Price (Present Value) of a Bond

The following examples illustrate how Microsoft Excel can be used to calculate common bond problems. Please be sure to refer to the chapters on the time value of money for examples of using spreadsheets to solve present value problems, as these same concepts are also used in solving bond problems.

You can use the following steps in Excel to determine the price or present value of a coupon bond. Suppose that a bond has a par or face value of $1,000, pays coupons semiannually at a 4% annual rate, and matures in 15 years. We can assume a YTM rate of 5%.

1. First, select Formulas from the Excel upper menu bar, and from the dialog box, select PV (see Figure 10.11).

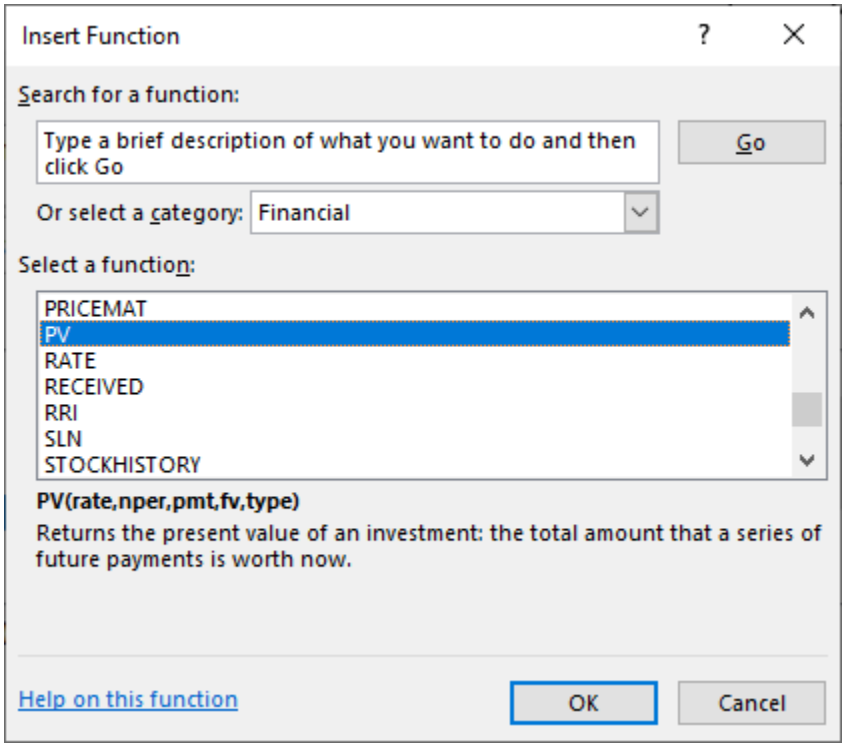


**Figure 10.11 Using Excel to Enter a PV (Present Value) Function**

2. When the PV function is selected, another dialog box will appear (see Figure 10.12). It is here that the function variables, or arguments, will be entered. It is preferable to use cell addresses to refer to these arguments so that the spreadsheet can be easily used again if inputs/arguments change.

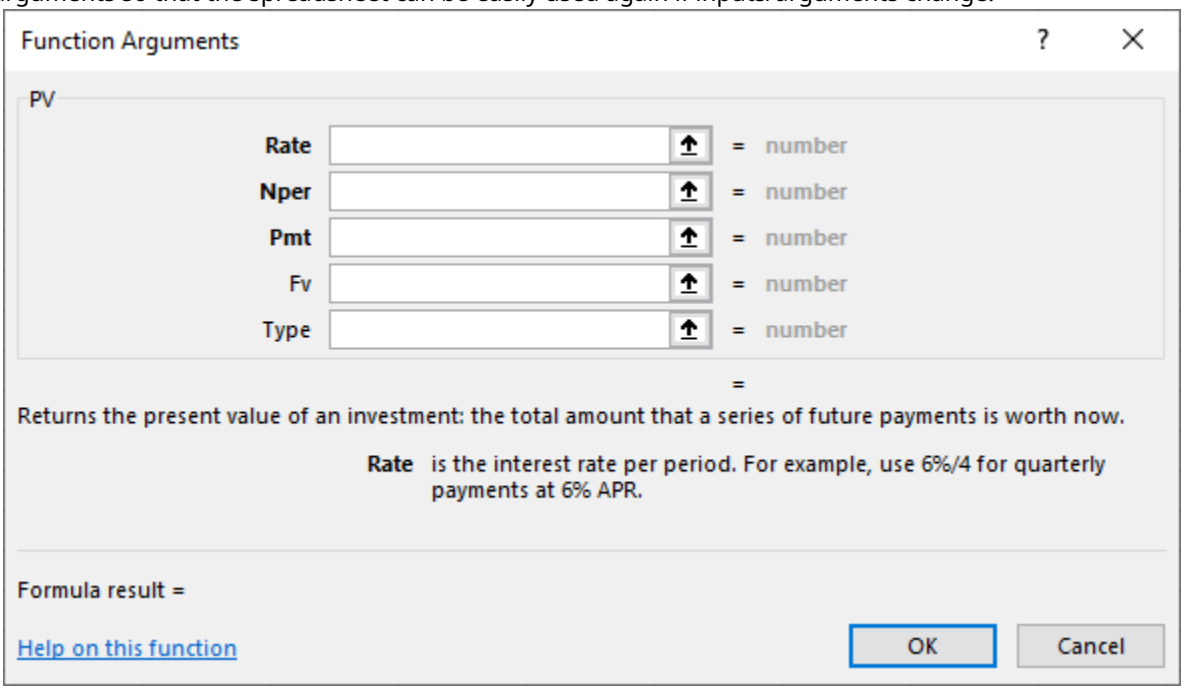


**Figure 10.12 Function Arguments Dialog Box**

3. Enter the function inputs or arguments (see Figure 10.13). We refer to the cell addresses as per our example spreadsheet.

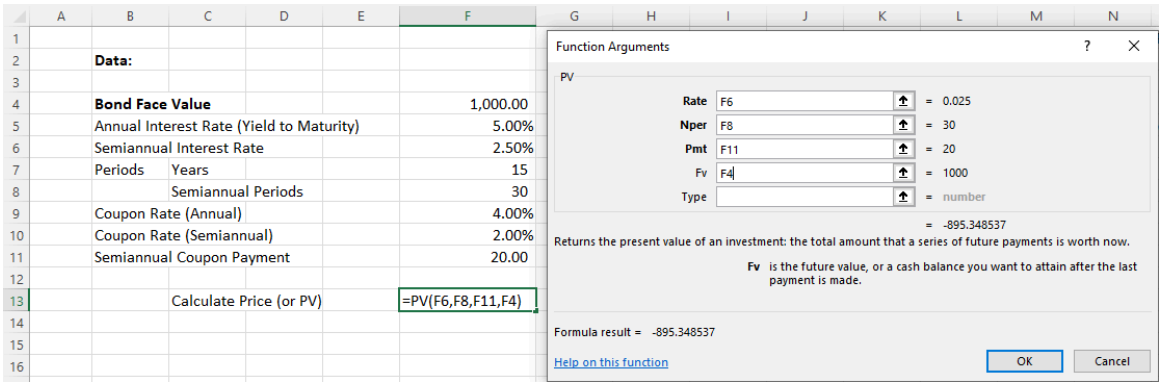


**Figure 10.13 Completed Data Entry Menu**

Note that the result, the price or present value, will appear in the bottom left section of the Function Arguments box once the arguments are entered. It will appear as a negative value because of the sign convention and because the bond face value in cell F4 was entered as a positive value.

## Calculating the Yield to Maturity (Interest Rate) of a Bond

Use the following steps in Excel to determine the YTM (interest rate) of a bond. Assume that you want to find the YTM of a $1,000, 3.5% bond with annual coupon payments that is selling for $675.00 and will mature in 12 years.

1. First, select Formulas from the Excel upper menu bar, and from the dialog box, select Rate (see Figure 10.14).

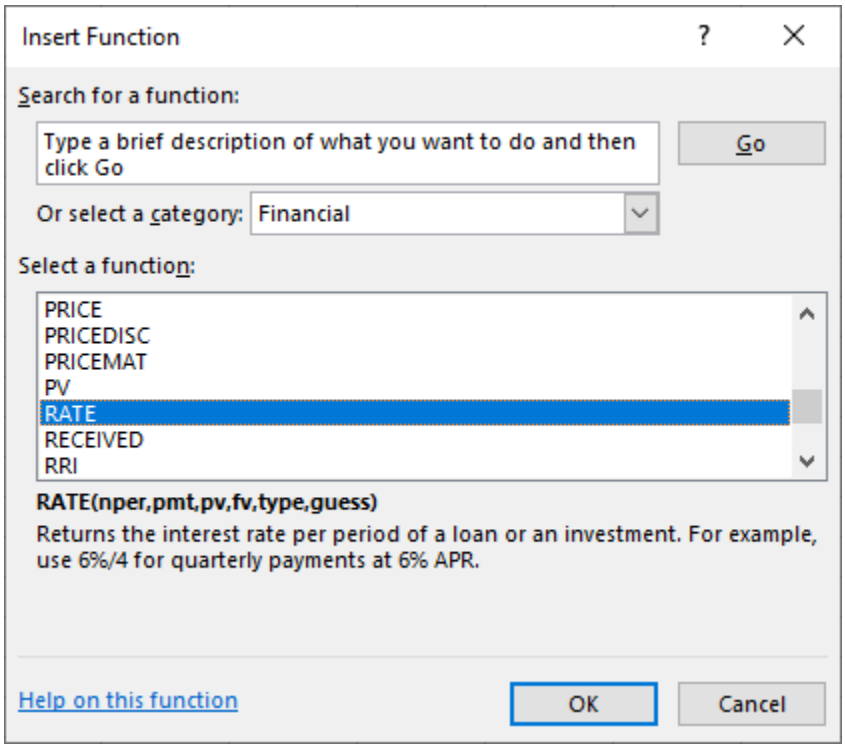


**Figure 10.14 Using Excel to Enter a Rate Function**

2. After the dialog box appears, enter the variables or arguments. As with our earlier example, we will use the preferred method of identifying the arguments with cell addresses (see Figure 10.15).

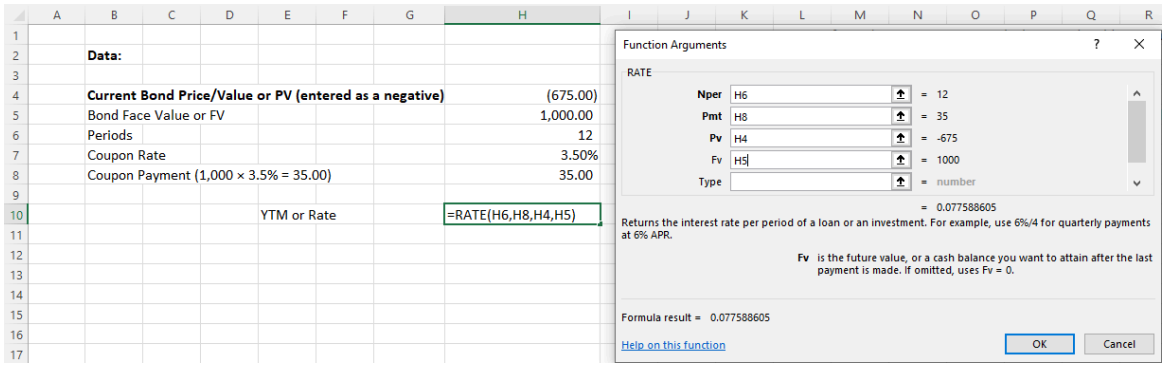


**Figure 10.15 Completed Data Entry Menu**

3. Again, after all arguments are entered through their correct cell references, the answer will appear in the lower left corner of the box. Once satisfied with the result, you can hit Enter to insert this final calculated value in your spreadsheet. This has been set up in this sheet in cell H10.

## THINK IT THROUGH

### Calculating a Coca-Cola Bond to Maturity

Earlier, we covered how a financial calculator could be used to determine the YTM of our Coca-Cola bond example. If we wanted to use an Excel spreadsheet to perform this calculation instead of a calculator, we would set up our spreadsheet as shown in the steps below. The current bond price, entered as a negative, is ($952.06). The bond face value of FV is $1,000; the time period is $7 \text{ years} \times 2$, or 14 semiannual periods; the coupon rate is $\frac{1\%}{2}$, or 0.05%; and the coupon payment is $5.00.

1. First, select Formulas from the Excel upper menu bar, and from the dialog box, select Rate (see Figure 10.16).

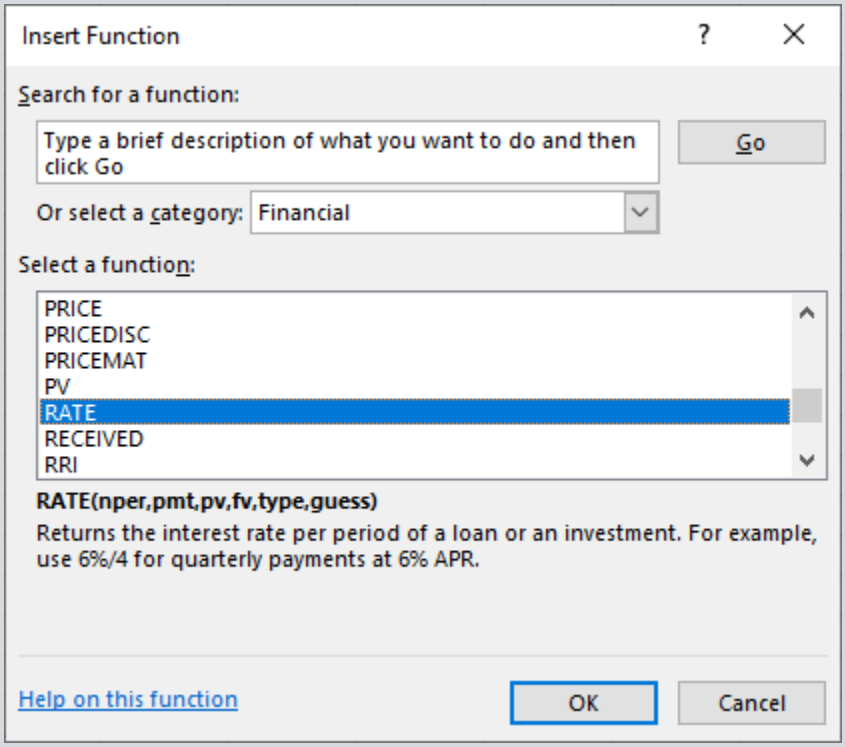


**Figure 10.16 Using Excel to Enter a Rate Function**

2. After the dialog box appears, enter the variables or arguments. As with our earlier examples, we will use the preferred method of identifying arguments with cell addresses (see Figure 10.17).

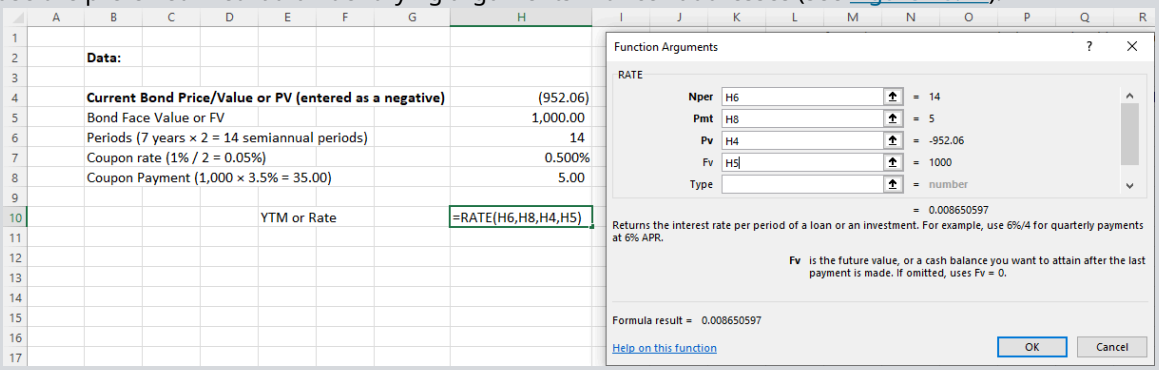


**Figure 10.17 Completed Data Entry Menu**

3. Again, after all arguments are entered through their correct cell references, the answer will appear in the lower left corner of the box. Once satisfied with the result, you can hit Enter to insert this final calculated value into your spreadsheet. This has been set up in this sheet in cell H10.

As noted above, remember that this is a semiannual rate because it was calculated using semiannual coupon payments and periods. To express it as an annual YTM rate, you must multiply it by 2.

## Calculating the Maturity Period (Term) of a Bond

You can use the following steps in Excel to determine the maturity period or term of a bond. Assume that you are considering investing in a bond that is selling for $820.00, has a face value of $1,000, and has an annual coupon rate of 3%. If the YTM is 10%, how long will it be until the bond matures?

1. First, select Formulas from the Excel upper menu bar, and from the dialog box, select Nper (see Figure 10.18).

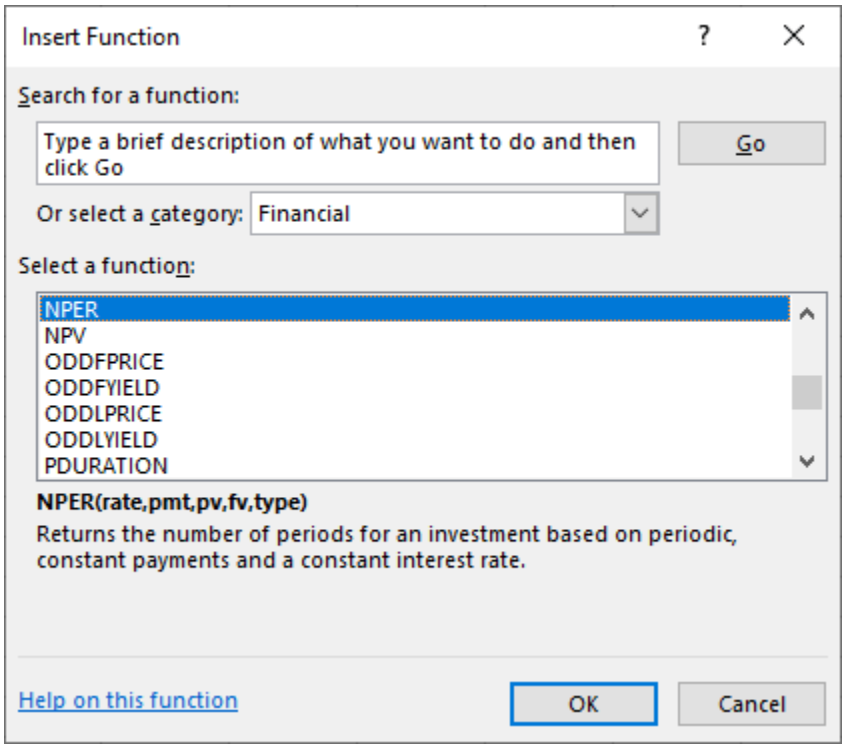


**Figure 10.18 Using Excel to Calculate Bond Time to Maturity**

2. When the dialog box appears, enter function arguments (see Figure 10.19). Once again, we will use the preferred method of using cell addresses as reference points.

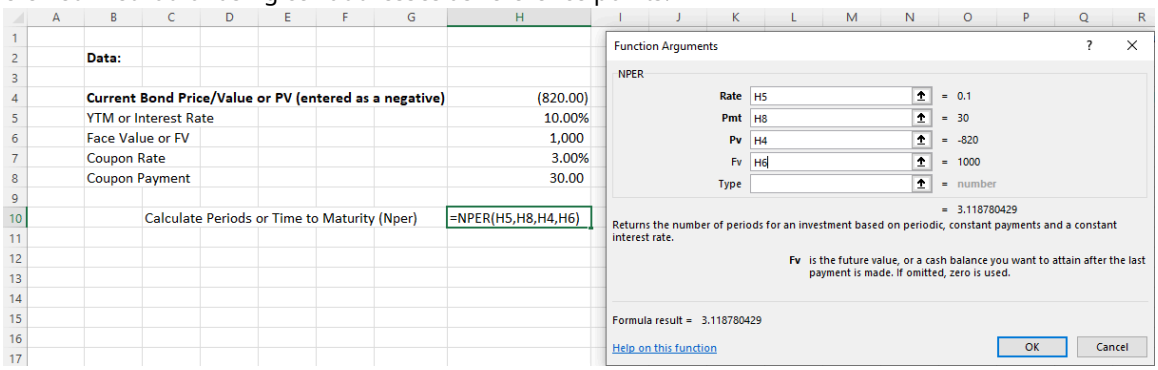


**Figure 10.19 Completed Data Entry Menu**

3. When arguments have all been entered, the answer will appear in the lower left of the Function Arguments box, as per the above. We arrive at a final answer of 3.12 years until this bond matures.

## Calculating Coupon Rate and Interest (Coupon) Payments

Here is how you would determine the coupon or interest rate and coupon payment using Excel. Assume a $1,000 face value bond is selling for $595, has 20 years until it matures, and has a YTM of 6.5%. What are the coupon rate and the periodic coupon payment amount of the bond?

1. First, select Formulas from the Excel upper menu bar, and from the dialog box, select PMT (see Figure 10.20).

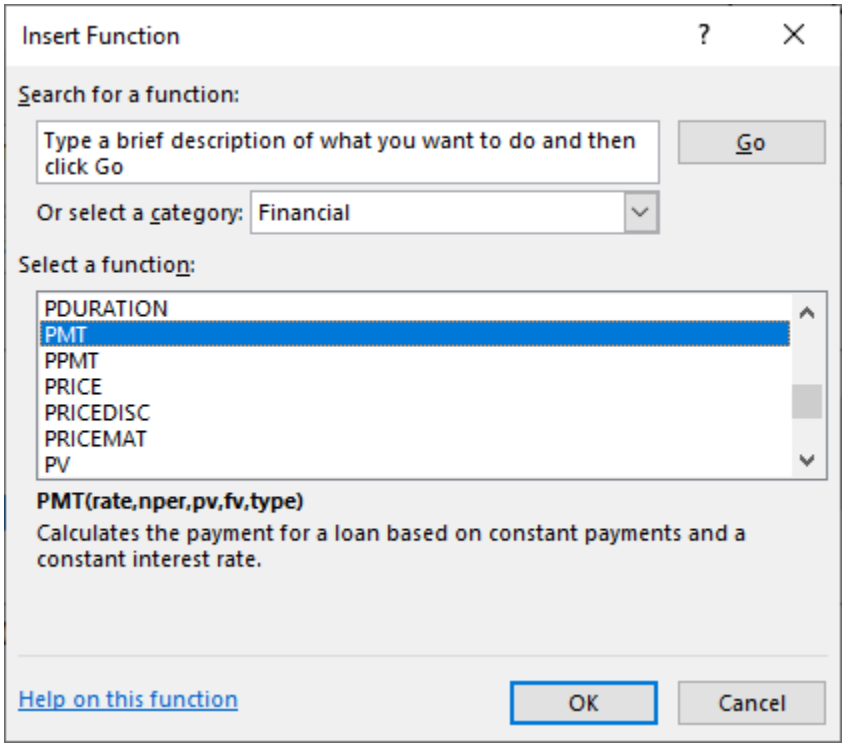


**Figure 10.20 Using Excel to Enter a PMT or Payment Function**

2. When the dialog box appears, enter function arguments. Once again, we will use the preferred method of using cell addresses as reference points (see Figure 10.21).

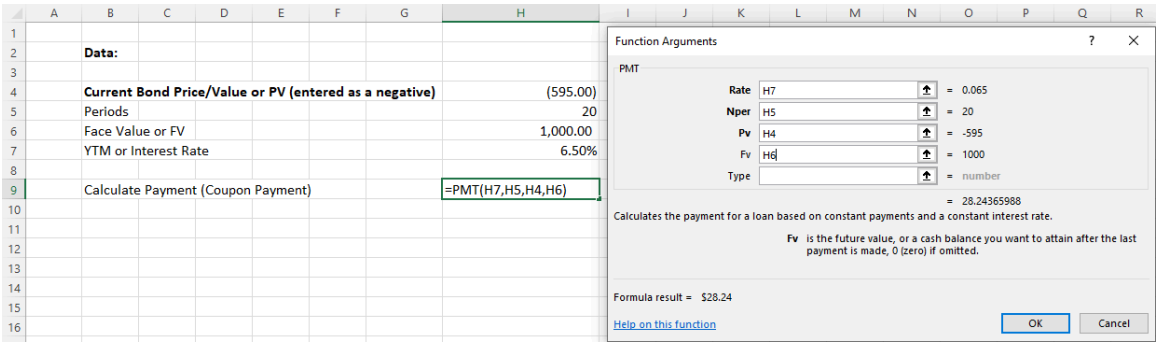


**Figure 10.21 Completed Data Entry Menu**

3. When arguments have all been entered, the answer will appear in the lower left of the Function Arguments box, as per the above. We arrive at a final answer of $28.24 as the coupon payment.

The coupon rate can be calculated by taking this coupon payment amount and dividing it by the face value:

$$\frac{\$28.24}{\$1{,}000} = 2.824\% \quad \textbf{10.13}$$

So, the coupon rate is 2.824%.

# Summary

## 10.1 Characteristics of Bonds

Bonds are typically a basic form of investment that entails a straightforward financial agreement between issuer and purchaser. There are three primary categories of bonds: government bonds, corporate bonds, and convertible bonds. These different types of bond vary depending on their issuer, length until maturity, interest rate, and risk.

## 10.2 Bond Valuation

It is important to ascertain what a given bond is worth to a willing buyer and a willing seller. We can price a bond using an equation, a calculator, or a spreadsheet. The essential steps are (1) identify the amount and timing of the future cash flow; (2) determine the discount rate; (3) find the present values of the lump sum principal and the annuity stream of coupons; and (4) add the present value of the lump sum principal and the present value of the coupons.

## 10.3 Using the Yield Curve

When interest rate yields are plotted against their respective maturity periods and these plotted points are connected, the resulting line is called the yield curve. The yield curve is a graphical representation of the term structure of interest rates. A yield curve always shows the value of yields (rates) on the *y*-axis and maturities or time periods on the *x*-axis.

## 10.4 Risks of Interest Rates and Default

Because bonds are fixed-income investments, they are subject to a number of risks that could have negative effects on their market value. The most common and best-known risks are interest rate risk and default risk, but there are some others risks that should be understood, such as credit risk, liquidity risk, duration risk, call risk, investment risk, and term risk. To assist potential bond investors in understanding some of these risks, bond ratings have been developed and are regularly published by a number of organizations to express their assessment of the risk quality of various bond issues.

## 10.5 Using Spreadsheets to Solve Bond Problems

Microsoft Excel can be used to solve common bond problems. It can be used to calculate the value of a coupon bond, the yield to maturity (interest rate) of a bond, the maturity period of a bond, and the coupon rate and interest (coupon) payments of a bond.

# Key Terms

**bond call** a feature of certain bonds or other fixed-income instruments that allows the issuer to repurchase and retire these instruments before maturity

**bond price** the present, discounted value of the future cash stream generated by a bond; the sum of the present values of all likely coupon payments and the present value of the par value at maturity

**bond ratings** grades assigned to bonds by rating services that indicate their overall credit quality

**Business Cycle Dating Committee** a subdivision of the National Bureau of Economic Research (NBER), the US government agency that maintains a chronology of US business cycles

**call risk** the risk that a bond issuer will redeem a callable bond prior to maturity

**capital gains** the increase in a capital asset's value that is realized when the asset is sold

**cash rate** the interest rate that a central bank, such as the Reserve Bank of Australia or the US Federal Reserve System, will charge commercial banks for loans; also known as the bank rate or the base interest rate

**convertible bonds** fixed-income corporate debt securities that yield interest payments but can be converted into a predetermined number of common stock or equity shares

**coupon payment** the periodic dollar value of interest that is paid to a bondholder by the bond issuer
**coupon rate** the amount of annual interest paid by the bond issuer; is multiplied by the face value of a bond to determine annual interest or coupon payment amounts
**credit risk** the risk taken by a bond investor that the bond issuer will default by failing to pay interest and repay the principal on schedule
**deep discount bonds** bonds that sell at significantly lower values than their par values
**default** when an issuer fails to make scheduled interest or principal payments on its bonds
**default risk** the risk taken by investors that payments will be delayed or will not occur
**discount bond** a bond currently trading for less than its par value in the secondary market; offers a coupon rate that is lower than prevailing interest rates
**duration** a measure of how much bond prices are likely to change if and when interest rates move
**duration risk** the risk associated with the sensitivity of a bond's price to a 1% change in interest rates
**Federal Reserve funds rate (federal funds rate)** the target interest rate, set by the Federal Reserve, at which commercial banks borrow and lend their excess reserves to each other
**Federal Reserve System (the Fed)** the central banking system of the United States, responsible for administering fiscal policy for the country
**fixed-income securities** investments that provide a return in the form of fixed, periodic interest payments and the eventual return of principal at maturity; the most common forms are bonds
**floating-rate bonds** bonds with variable interest rates that allow investors to benefit from rising interest rates
**interest income** annual interest amounts paid, or coupon payments made, on a bond between its issue date and the date of maturity
**interest rate risk** the risk of investment losses that result from changes in interest rates
**investment grade** describes a municipal or corporate bond with a rating that indicates it presents a low risk of default
**junk bonds** bonds that have been given a low credit rating, below investment grade; riskier than other bonds due to a greater chance that the issuer will default or experience a credit event
**liquidity risk** risk that stems from the lack of marketability of an investment, meaning that it cannot be bought or sold quickly enough to prevent or minimize a loss
**London Interbank Offered Rate (LIBOR)** a benchmark interest rate at which major global banks lend to one another in the international interbank market for short-term loans
**maturity date** the date on which a bondholder ceases to receive interest payments on a bond investment and instead is repaid its par, or face, value
**municipal bonds ("munis")** debt securities issued by state and local governments; can be thought of as loans that investors make to local governments to fund infrastructure
**par value** also called the face amount or face value; the value written on the front of the bond, which is the amount of money that bond issuers promise to be paid at maturity
**premium bond** a bond that is trading above its par value in the secondary market; offers a coupon rate that is higher than the current prevailing interest rates being offered
**prime rate** the interest rate that banks charge creditworthy corporate customers; among the most widely used benchmarks for setting home equity lines of credit and credit card rates, based on the federal funds rate set by the Federal Reserve
**rating agencies (bond rating services)** independent service agencies, such as Fitch, Moody's, or Standard & Poor's, that perform the isolated function of credit risk evaluation
**realized return** the actual return that an investor earns over a given time period through the buying and selling of a security
**reinvestment risk** the risk that an investor will be unable to reinvest cash flows received from an investment (e.g., coupon payments or interest) at a rate comparable to their current rate of return
**savings bonds** debt securities purchased by investors, as a personal investments or as gifts, that the US government issues to pay for certain public or government programs

**term risk** the risk of potentially earning lower returns on longer-term bond holdings compared to those potentially available when making several shorter-term investments over the same period of time

**US Treasury bills (T-bills)** short-term US government debt obligations backed by the Treasury Department with a maturity of one year or less

**US Treasury note rate** the interest rate that the US government pays to borrow money for different lengths of time; notes are issued in terms of two, three, five, seven, and 10 years

**yield curve** a line that plots yields (interest rates) of bonds having equal credit quality but differing maturity dates; gives an idea of future interest rate changes and economic activity

**yield to maturity (YTM)** the total return anticipated on a bond if the investment is held until maturity

**zero-coupon bonds** bonds that are issued at a deep discount from face value and offer no interest or coupon payments

## CFA Institute

This chapter supports some of the Learning Outcome Statements (LOS) in this CFA® Level I Study Session (https://openstax.org/r/study-session-14). Reference with permission of CFA Institute.

## Multiple Choice

1. When solving bond problems relating to a bond that pays interest on a quarterly basis, the _____ before being applied.
   **a.** quoted annual yield to maturity should be multiplied by 4
   **b.** quoted number of years until maturity should be divided by 4
   **c.** quoted annual coupon payments should be divided by 4
   **d.** stated face value should be divided by 4

2. Which of the following is NOT an adjustment that must be made when interest is paid semiannually instead of annually?
   **a.** Dividing the annual coupon payment by 2
   **b.** Dividing the annual interest rate by 2
   **c.** Dividing the total number of years by 2
   **d.** Dividing the annual yield to maturity by 2

3. Which of the following is NOT considered a factor that influences a bondholder's required rate of return?
   **a.** Financial risk
   **b.** Other investments by the bondholder
   **c.** Risk premium
   **d.** Business risk

4. How might an investment in a bond fund be affected by a decline in interest rates?
   **a.** The fund investment would not be affected.
   **b.** The fund investment would likely decrease in value.
   **c.** The fund investment would likely increase in value.
   **d.** Coupon payments from bonds in the fund would decline.

5. Interest rates and bond prices _____.
   **a.** are unrelated
   **b.** have an inverse relationship
   **c.** have a direct relationship
   **d.** are both economic factors set by central banks

6. The coupon rate of a bond is typically _____.
   **a.** fixed at the time of bond issuance
   **b.** subject to change based on the federal funds rate

**c.** zero in the case of zero-coupon bonds
**d.** Both A and C

**7.** A zero-coupon bond is a bond that _____.
**a.** has no value
**b.** has no periodic coupon payments
**c.** has been rated below investment grade
**d.** Both A and C

**8.** A bond that has a coupon rate less than prevailing interest rates will _____.
**a.** sell at par value
**b.** sell at a discount
**c.** sell at a premium
**d.** be overpriced

**9.** Determining bond prices often involves using which two TVM (time value of money) equations?
**a.** The future value of a lump sum and the present value of a lump sum
**b.** The present value of an annuity and the future value of a lump sum
**c.** The future value of an annuity and the present value of a lump sum
**d.** None of the above

**10.** A normal yield curve will _____.
**a.** slope downward as it moves along its *x*-axis (term).
**b.** slope upward as it moves along its *x*-axis (yield).
**c.** fluctuate depending on the federal funds rate
**d.** slope upward as it moves along its *x*-axis (term).

**11.** An inverted yield curve is an indication that _____.
**a.** long-term yields and interest rates are higher than short-term rates
**b.** the economy is in the process of a significant recovery
**c.** short-term yields and interest rates are higher than long-term rates
**d.** the yields to maturity on all bonds are less than market interest rates

**12.** Bond laddering is _____.
**a.** a risky bond investment strategy that may yield tremendous returns
**b.** a strategy in which bonds with several different maturity periods are added to a portfolio
**c.** a strategy that involves replacing equity investments with bonds in a portfolio
**d.** a bond strategy that sacrifices diversity for potential capital gains

**13.** A call feature _____.
**a.** is desirable to an investor
**b.** may cause additional risk for the bond issuer
**c.** may cause additional risk for an investor
**d.** Both A and B

**14.** The duration of a bond is _____.
**a.** a measurement of the bond's overall risk
**b.** synonymous with the bond's term
**c.** a measurement of how long an investor holds the bond
**d.** a measurement of the bond's sensitivity to interest rate changes

## Review Questions

**1.** What is a junk bond?

2. Briefly describe interest income within the context of bond investments.
3. Briefly describe the two types of cash flow that a bondholder will receive from the issuer.
4. What is an inverted yield curve, and what is its significance?
5. Describe reinvestment risk for a bondholder.

## Problems

1. A $1,000 Expo Corp. bond has a coupon rate of 5%, pays interest semiannually, and matures in six years. If the yield to maturity is 7%, what is the bond's value today?
2. A $1,000 Omega Corp. bond has an 8% coupon rate that is paid semiannually. The bond matures in three years. If the current price of the bond is $1,125, what is the yield to maturity?
3. You are considering buying a bond that is currently priced at $830, has a face value of $1,000, and matures in seven years. If interest is paid semiannually and the bond has a yield to maturity of 6%, what is the bond's annual coupon rate?
4. A $1,000 Noah Corp. bond has a coupon rate of 5% with semiannual payments, matures in 10 years, and has a yield to maturity of 6.5%. What is the bond's current price?
5. Chronowerx Inc. has issued a bond that has a face value of $1,000, a 3% coupon rate (with semiannual interest), and a maturity date four years from now. If the bond's current price is $895, what is its yield to maturity?
6. You are considering adding a $1,000, 25-year bond to your portfolio. It has a coupon rate of 8%, which is paid annually, and your required return is 10%. What is the current price of the investment?
7. A Cameron Corp. bond has a $1,000 par value, a 5 percent coupon rate paid semiannually, and nine years until maturity. If similar investments yield 6%, what is the current value of Cameron Corp. bonds?
8. McLaren Motors just issued a series of $1,000.00 bonds with a 10-year maturity and an 8% coupon rate, paid quarterly. If you purchase a McLaren bond at a price of $920.00, what is your required rate of return?
9. Three years ago, Petty Partners Inc. issued 15-year, $1,000 bonds that are currently priced at $911.37. If the prevailing rate of return on similar investments is 5%, what is the coupon rate on Petty Partners bonds, and what is the annual interest payment?
10. A $1,000 Riker Corp. bond has a 20-year maturity and a 6% coupon rate, with interest paid annually. If similar bonds from Riker Corp. are yielding 4%, what is the current market value of the Riker issue?
11. A $1,000 bond that matures in eight years, has quarterly coupon payments of $25, and is currently priced at $962.00 will have a yield to maturity of _____.

## Video Activity

### Using TI BA II+ to Price a Bond

Access multimedia content (http://openstax.org/books/principles-finance/pages/10-video-activity)

1. If you are provided with annual information in a bond problem, which bond variables must be adjusted to accommodate semiannual compounding periods, and how must they be adjusted? Review the video to follow along as this information is provided.
2. Following the instructions laid out in the video, practice using a calculator to find the price of a bond under two scenarios. The first scenario should be when compounding periods are annual, or once a year, and the second scenario should be when compounding periods are semiannual, or once every six months.

Start out this exercise with the bond factor input variables that are used in the video: par value of $1,000, annual coupon rate of 4%, time to maturity of 10 years, and yield to maturity of 8%. Calculate the current value or price of the bond under both of the different compounding period scenarios.

Once you have arrived at the same results demonstrated in the video, practice calculating prices using different bond factor variables for inputs, changing time or years to maturity, coupon rate (and coupon payments), and yield to maturity until you are completely confident using a financial calculator to find the price or value of any bond.

## Bond Pricing, Valuation, Formulas, and Functions in Excel

Access multimedia content (http://openstax.org/books/principles-finance/pages/10-video-activity)

Review the examples included in this video, and practice setting up spreadsheets that solve for each of the five primary bond variables using the values in the videos (maturity 10 years, coupon rate 10%, coupon payment $100, yield to maturity 8%, and par value $1,000). Parallel the spreadsheets that are set up in the video, ensuring that you arrive at the same results for each bond variable amount.

3. Name and describe the five primary bond variables that can be solved using Excel spreadsheets.
4. What are the Excel functions that allow you to perform these calculations, and where in the standard Excel spreadsheet are they located?

11

# Stocks and Stock Valuation

**Figure 11.1** In addition to bonds, corporations will often issue common stock as a means of raising necessary capital to finance future operations. (credit: modification of "New York Stock Exchange Huge US Flag Photo i018" by Grant Wickes/flickr, CC BY 2.0)

## Chapter Outline

**11.1** Multiple Approaches to Stock Valuation
**11.2** Dividend Discount Models (DDMs)
**11.3** Discounted Cash Flow (DCF) Model
**11.4** Preferred Stock
**11.5** Efficient Markets

## Why It Matters

Similar to bonds, shares of **common stock** entitle investor owners to a portion of a company's future earnings and cash flows. However, stocks differ significantly from bonds in how they are issued and managed by companies, the methodology used to calculate their values in public markets, and how they can generate income and eventual value for individual investors.

With common stock, there is no specific promise of how much cash investors will receive or when they will receive it. This differs from bond investments, which are valued entirely on the basis of their guaranteed timing of future cash flows to bondholders.

This means that with stocks, there are no maturity dates, face values, or coupon payment guarantees. It also means that stocks do not promise any specified cash flows in the form of coupons or a face value payment at some point in the future. Instead, stocks (only some, not all) may pay dividends. These dividends are declared after shares of stock have been issued by a company and then purchased by the investing public. Following a dividend declaration, the designated per-share amounts are paid to shareholders of record on a specified date, also determined by a company's board.

Because stock investments carry no guarantee of payments to investors, they are far riskier than bonds and other forms of fixed-income investments.

While there are many reasons for an investor to choose to purchase common stock, three of the most common reasons are

- to use stocks as instruments or repositories for maintaining value;
- to accumulate wealth over the term of the stock investment; and
- to earn income through capital gains and dividend payments.

As with any financial instrument, common stock purchases offer advantages and disadvantages to investors. Important advantages include the following:

- Returns through dividends and price appreciation of shares can be substantial.
- Stocks are a liquid form of investment and can be bought or sold within **secondary markets** relatively easily.
- Information about companies, markets, and important trends are widely published and readily available to the investing public.

These advantages are significant and lead many individuals to move into stock investments. Yet it is important to realize that stock has some significant disadvantages, which can include the following:

- General risk levels are greater than with bonds or other fixed-income investments.
- Timing the buy-and-sell transactions of stock can be tricky and may lead to losses or not taking full advantage of share price opportunities.
- Dividends (provided that the stock does indeed pay them, as not all do) are uncertain and subject to change based on decisions of company management.

We will discuss these topics in this chapter and cover many of the details regarding why corporations issue common stock and why investors purchase that stock.

# 11.1 Multiple Approaches to Stock Valuation

## Learning Outcomes

By the end of this section, you will be able to:

- Define and calculate a P/E (price-to-earnings) ratio given company data.
- Determine relative under- or overvaluation indicated by a P/E (price-to-earnings) ratio.
- Define and calculate a P/B (price-to-book) ratio given company data.
- Determine relative under- or overvaluation indicated by a P/B (price-to-book) ratio.
- Define and detail alternative valuation multipliers, including P/S (price-to-sales) ratio, P/CF (price-to-cash-flow) ratio, and dividend yield.

## The Price-to Earnings (P/E) Ratio

Experienced investors use a number of different methods to evaluate information on companies and their common stock before deciding on any potential purchase. One of the most popular techniques used by investors and analysts is to study a company's financial statements in order to uncover basic fundamental information on the company. This involves calculating a number of financial ratios that help identify trends, bringing elements of operational performance to light and allowing for clearer analysis and evaluation.

A well-proven analytical approach for investors to use in evaluating common stock is to review the overall market value of the company that issues a stock. One of the most consistently used calculations in this analysis, which has important applications in company and common stock evaluation, is the **price-to-earnings (P/E) ratio**.

The P/E ratio is computed using the following formula:

$$\text{P/E Ratio} = \frac{\text{Price per Share}}{\text{Earnings per Share}} \tag{11.1}$$

The P/E ratio is extremely useful to analysts in that it shows the expectations of the market. Essentially, the P/E ratio is representative of the price an investor must pay for every unit of current (or future) corporate earnings.

Bottom-line earnings are a critical factor in valuing common stock. Investors will always want to know how profitable a company is now as well as how profitable it will be in the future. When a company's bottom line remains relatively flat over a period of time, leaving **earnings per share (EPS)** relatively unchanged, the P/E ratio can be interpreted as the payback period for the original amount paid for each share of common stock.

For example, the common stock price of Cameo Corp. is currently at $24.00 a share, and its EPS for the year is $4.00. Cameo's P/E ratio is calculated as

$$\text{P/E}_{\text{Cameo}} = \frac{\$24.00}{\$4.00} = 6 \qquad \textbf{11.2}$$

This ratio would typically be expressed in the form $6\times$. Essentially, this means that investors are willing to pay up to six dollars for every one dollar of earnings. It can also be stated that Cameo stock is currently trading at a multiple of six.

The P/E ratio is typically expressed in two primary ways. The first is as a metric listed by most finance websites and often carries the notation *P/E (ttm)*. This refers to the Wall Street acronym for "trailing 12 months" and signals the company's operating performance over the past 12 months.

Another form of the P/E ratio is known as the forward (or leading) P/E. This uses future earnings projections rather than actual trailing amounts. The leading P/E, sometimes called the *estimated price to earnings*, is useful for comparing current earnings to future earnings and helps provide a clearer picture of what earnings may look like, assuming there are no major changes in the company's operations or accounting treatments.

Referring back to our calculation for Cameo Corp. above, because the current EPS was used in the calculation, this ratio would be classified as a trailing P/E ratio. If we had used an estimated or projected EPS as the denominator in the calculation, it would then be considered a leading P/E ratio.

Analyzing a company's P/E ratio alone or within a vacuum will actually tell an analyst very little. It is only when a company's P/E is compared to historical P/E ratios or the P/E ratios of other companies in the same industry that it becomes a useful tool for analysis. One of the most important benefits of using comparative P/E ratios is that they can standardize stocks with different prices and various earnings levels.

Generally speaking, it is very difficult to make any conclusions about a stand-alone **stock value**, such as whether a stock that has a ratio of $8\times$ is a good buy at its current price or if a stock with a P/E ratio of $35\times$ is too expensive, without performing any relevant comparisons or further analysis.

Analysts have many different ways to interpret P/E ratio data. One of the most common interpretations is that firms with high P/E ratios should be growth companies. Also, a high P/E ratio could mean that a stock's price is high relative to earnings and possibly overvalued. This could signal a possible undesired downward adjustment in market price in the future.

We can extrapolate from the argument above to put forward the idea that stocks with low P/E ratios should be stabler, more mature organizations. A low P/E might indicate that the current stock price is low relative to earnings and that there may be an opportunity to take advantage of upward price movements and potential investment gains through stock price appreciation.

While this information is often very useful for evaluating stocks and making investment decisions, caution must always be used, as a current stock price may simply be out of line with the company's earning potential, which would mean that price adjustments are likely to occur in the short term. This is why experienced analysts and investors will use multiple evaluation techniques when conducting stock analysis and evaluation and not rely solely on insights provided by a single set of facts or one form of statistical measurement.

## The Price-to-Book (P/B) Ratio

Another financial ratio commonly used by investors and analysts is the **price-to-book (P/B) ratio**, also called the market-to-book (M/B) ratio. This is a financial metric used to evaluate a company's current market value

relative to its book value.

The market value, or **market capitalization**, of a company is defined as the current price of all its outstanding shares of common stock. This is essentially equal to the total value of the company as perceived by the market. For all intents and purposes, the book value is representative of the residual of a company after it has liquidated all assets and paid off all of its liabilities.

Book value can be determined by performing some financial analysis on a company's balance sheet. Essentially, analysts will use the P/B ratio to compare a business's available net assets relative to the current sales price of its stock. The price-to-book-value ratio formula is

$$\text{P/B Ratio} = \frac{\text{Market Price per Share}}{\text{Book Value per Share}} \tag{11.3}$$

One of the primary uses of the P/B ratio is to understand market perceptions of a particular stock's value. It is often the metric of choice for evaluating financial services firms such as real estate firms, insurance companies, and investment trusts. The P/B ratio has a notable shortcoming, however, in that it does not evaluate companies that have a high level of **intangible assets** such as patents, trademarks, and copyrights.

Ultimately, this ratio will tell an analyst exactly how much potential investors are willing to pay for each dollar of asset value. The PB(M/B) ratio is computed by dividing the current closing price of the stock by the company's current book value per share, which is calculated by either of the following two equations:

$$\text{P/B Ratio} = \frac{\text{Market Capitalization}}{\text{Net Book Value}}$$
$$\text{P/B Ratio} = \frac{\text{Price per Share}}{\text{Net Book Value per Share}} \tag{11.4}$$

**Net book value** is equal to net assets, or the total assets minus the total liabilities of the company.

Analysts often consider a low P/B ratio (less than 1) to indicate that a stock is undervalued and a higher ratio (greater than 1) to mean that a stock is overvalued. A low ratio may be an indication that something is wrong with the company or that an investor may be paying too much for any residual value should the company be liquidated.

However, many market experts will argue the exact opposite of the above interpretations. Because of these discrepancies in interpretation and overall variance of opinion, the use of alternate stock valuation metrics, either in addition to or in place of the P/B ratio, is always worth exploring.

In conclusion, the P/B ratio can help a company understand if its net assets are comparable to the market price of its stock. However, as with the P/E ratio, it is always a good idea to compare P/B ratios of companies within the same industry and use them in conjunction with other metrics and analytical methodologies.

LINK TO LEARNING

### Price-to-Earnings Ratio and Price-to-Book Ratio

Two videos cover the price-to-earnings (P/E) ratio (https://openstax.org/r/price-to-earnings) and the price-to-book (P/B) ratio (https://openstax.org/r/price-to-book_ratio). These are excellent introductory videos that will provide you with helpful information on what these ratios represent and how they can be used in stock valuation.

## Alternative Multipliers

There are two main types of valuation metrics multiples used to value common stock. These are **equity multiples** and **enterprise value (EV) multiples**. Additionally, there are two primary methods by which to perform analysis using these multiples. These methods are **comparable company analysis (comps)** and

**precedent transaction analysis (precedents)**.

Experienced financial analysts advocate the use of multiples in valuation analysis for a number of reasons, the most important being that they help generate realistic and sound judgments of enterprise values (total company values), they are relatively easy to use and interpret, and they can provide helpful information on a company's overall financial condition when used appropriately.

However, it should be noted that simplicity may have some important disadvantages. When such complex information is reduced to a single equation or final value, it can easily be misunderstood, and the influence of important factors may be masked or lost in the evaluation process.

What's more, the calculation of multiples represents a snapshot in time for a firm and cannot easily show how a company grows or progresses. Thus, these calculations are only applicable to short-term analysis, not to long-term scenarios.

## Equity Multiples

Equity multiples are especially useful for investment decisions when an investor aspires to minority positions in companies. Below are some common equity multiples used in valuation analyses.

The price-to-earnings (P/E) ratio, which we discussed earlier, is probably the most common equity multiple used in stock valuation because it is relatively simple to calculate and all necessary data are easily accessible by analysts and investors. The market-to-book (M/B), or price-to-book (P/B), ratio is also useful if assets primarily drive a company's earnings. Again, it is computed as the proportion of share price to book value per share.

**Dividend yield** is another form of equity multiple and is primarily used when conducting comparisons between cash returns and investment types. Dividend yield is computed as the proportion of **dividend** per share to share price. The **price-to-sales (P/S) ratio** is an additional metric used for firms that are experiencing financial losses. The P/S ratio is often used for quick estimates and is computed as the proportion of share price to sales (or revenue) per share.

Another useful metric is the **price-to-cash-flow (P/CF) ratio**. The P/CF ratio is used to compare a company's market value to its operating cash flow (or the company's stock price per share to its operating cash flow per share). This measurement is suitable only in certain cases, such as when a company has substantial noncash expenses (e.g., **depreciation** or **amortization**). In some situations, companies may have positive cash flows but still show a bottom-line loss due to large noncash expenses. The P/CF ratio is helpful for arriving at a less distorted view of such a company's value.

While these various metrics are important, a financial analyst must always consider that companies often operate under their own unique sets of circumstances that ultimately will influence many of these equity multiples.

## Enterprise Value (EV) Multiples

The following are some common EV multiples used in valuation analyses:

Gordon growth model is as follows

$$\frac{\text{Enterprise Value}}{\text{Revenue}} \tag{11.5}$$

$$\frac{\text{Enterprise Value}}{\text{EBIT}} \tag{11.6}$$

$$\frac{\text{Enterprise Value}}{\text{EBITDA}} \tag{11.7}$$

$$\frac{\text{Enterprise Value}}{\text{EBITDAR}} \tag{11.8}$$

EV multiples take an increasingly important role when value decisions surround recent mergers and acquisitions. **Enterprise value (EV)** is a measurement of the total value of a company. Companies often believe that EV offers a more accurate representation of a firm's total value than a basic market capitalization method. Generally, EV is perceived to offer an aggregate value of the firm as an enterprise, which is a more comprehensive measurement (see Figure 11.2).

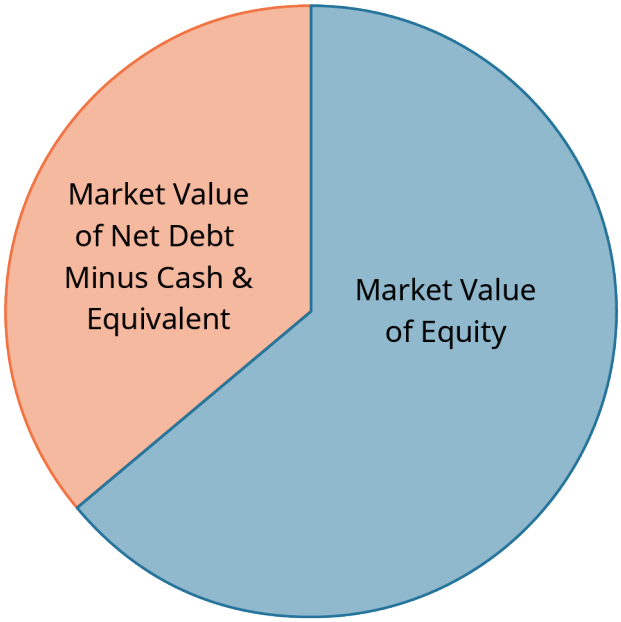


**Figure 11.2 Enterprise Value: The Complete Picture**

Following are two of the most common enterprise values metrics used in valuing companies and their common stock:

**EV/Revenue (EV/R).** Also called EV/Sales, EV/R is a valuation metric used to understand a company's total valuation compared to its annual sales levels. EV/R can help provide an analyst with an idea of exactly how much investors pay for every dollar of a company's sales revenue.

EV/R is considered a relatively crude metric but can be useful when analyzing companies that have different methods of revenue recognition. P/E ratios, for example, can be significantly affected by changes in the accounting policies of companies being evaluated. This is another reason why multiple metrics should be used in valuations.

Additionally, EV/R is a useful measure for companies that are consuming cash or experiencing financial losses. Such companies may be start-ups or emerging technology firms that have not fully matured and are still in a growth stage of development.

**EV/EBIT.** A firm's earnings before interest and taxes (**EBIT**) is an indicator of its profitability before the effects of interest or taxes. EBIT is also referred to as operating earnings, operating profit, and profit before interest and tax.

- **EV/EBITDA.** EV/EBITDA is a ratio that compares a company's enterprise value (EV) to its earnings before interest, taxes, depreciation, and amortization (EBITDA). EBITDA is often used by analysts as a substitute for cash flow and can be applied to capital analysis using tools such as net present value and internal rate of return. It is relatively easy to calculate, as all information required to compete the calculation is available from any publicly traded company's financial statements. Because of this, the EV/EBITDA ratio is a commonly used metric to compare the relative values of different businesses.
- **EV/EBITDAR.** Another form of valuation based on enterprise value is EV/EBITDAR. This metric divides enterprise value by earnings before interest, tax, depreciation, amortization, and rental costs (EBITDAR).

This multiple is used in businesses that have substantial rental and lease expenses, such as hotel chains and airlines. Capital investment can differ significantly for these firms, and when assets are leased, these companies tend to have artificially lower debt and operating income compared to firms that actually own their assets.

**EV/Capital Employed.** The EV-to-**capital employed** ratio is a measure of enterprise value compared to the level of capital used by a business. For example, a business with a large capital basis is bound to carry a large enterprise value simply due to its large capital holdings.

### Final Thoughts on Valuation Ratios and Multiples

There are many equity and enterprise value multiples used in company valuation, but the discussions above cover those that are most commonly used. In any case, gaining a thorough understanding of each multiple and its related concepts can help analysts make better use of these metrics in their stock analysis and valuation efforts. Also, as discussed, it is important that analysts and technicians use multiple ratios and alternate measures for any evaluation of a company and its common stock. Not doing so will limit the ultimate interpretation of the results, can lead to incorrect conclusions, and may cause fundamental mistakes in overall investment strategy.

LINK TO LEARNING

Graph of Historical P/E for S&P 500

Look at the 90-year historical average P/E ratio of the S&P 500 (https://openstax.org/r/90-year_historical_average_P/E). When viewing this information on historical P/E ratios, think about the following:

- Note that the general trend for historical P/E ratios has been one of growth.
- Note that in May 2009, the P/E ratio reached a staggering $123.73\times$, the highest ratio in US history. This was primarily due to depressed earnings during the Great Recession.

## 11.2 Dividend Discount Models (DDMs)

### Learning Outcomes

By the end of this section, you will be able to:

- Identify and use DDMs (dividend discount models).
- Define the constant growth DDM.
- List the assumptions and limitations of the Gordon growth model.
- Understand and be able to use the various forms of DDM.
- Explain the advantages and limitations of DDMs.

The **dividend discount model (DDM)** is a method used to value a stock based on the concept that its worth is the present value of all of its future dividends. Using the stock's price, a required rate of return, and the value of the next year's dividend, investors can determine a stock's value based on the total present value of future dividends.

This means that if an investor is buying a stock primarily based on its dividend, the DDM can be a useful tool to determine exactly how much of the stock's price is supported by future dividends. However, it is important to understand that the DDM is not without flaws and that using it requires assumptions to be made that, in the end, may not prove to be true.

## The Gordon Growth Model

The most common DDM is the **Gordon growth model**, which uses the dividend for the next year ($D_1$), the **required return** ($r$), and the estimated future dividend **growth rate** ($g$) to arrive at a final price or value of the stock. The formula for the Gordon growth model is as follows:

$$\text{Stock Value} = \frac{D_1}{r - g} \tag{11.9}$$

This calculation values the stock entirely on expected future dividends. You can then compare the calculated price to the actual market price in order to determine whether purchasing the stock at market will meet your requirements.

LINK TO LEARNING

Dividend Discount Model

Watch this short video on the dividend discount model (https://openstax.org/r/short_video_on_the_dividend) and how it is used it in stock valuation and analysis.

The Gordon growth model equation is presented and then applied to a sample problem to demonstrate how the DDM yields an estimated share price for the stock of any company.

Now that we have been introduced to the basic idea behind the dividend discount model, we can move on to cover other forms of DDM.

## Zero Growth Dividend Discount Model

The zero growth DDM assumes that all future dividends of a stock will be fixed at essentially the same dollar value forever, or at least for as long as an individual investor holds the shares of stock. In such a case, the stock's **intrinsic value** is determined by dividing the annual dividend amount by the required rate of return:

$$\text{Stock Value} = \frac{\text{Annual Dividends}}{\text{Required Rate of Return}} \tag{11.10}$$

When examined closely, it can be seen that this is the exact same formula that is used to calculate the present value of a perpetuity, which is

$$\text{Present Value} = \frac{\text{Dividend}}{\text{Discount Rate}} \tag{11.11}$$

For the purpose of using this formula in stock valuation, we can express this as

$$\text{PV} = \frac{D}{r} \tag{11.12}$$

where PV is equal to the price or value of the stock, $D$ represents the dividend payment, and $r$ represents the required rate of return.

This makes perfect sense because a stock that pays the exact same dividend amount forever is no different from a **perpetuity**—a continuous, never-ending annuity—and for this reason, the same formula can be used to price preferred stock. The only factor that might alter the value of a stock based on the zero-growth model would be a change in the required rate of return due to fluctuations in perceived risk levels.

**Example:**

What is the intrinsic value of a stock that pays $2.00 in dividends every year if the required rate of return on

similar investments in the market is 6%?

**Solution:**

We can apply the zero growth DDM formula to get

$$\text{Stock Value} = \frac{\$2.00}{0.6} = \$33.33 \quad \textbf{11.13}$$

While this model is relatively easy to understand and to calculate, it has one significant flaw: it is highly unlikely that a firm's stock would pay the exact same dollar amount in dividends forever, or even for an extended period of time. As companies change and grow, dividend policies will change, and it naturally follows that the payout of dividends will also change. This is why it is important to become familiar with other DDMs that may be more practical in their use.

## Constant Growth Dividend Discount Model

As indicated by its name, the constant growth DDM assumes that a stock's dividend payments will grow at a fixed annual percentage that will remain the same throughout the period of time they are held by an investor. While the constant growth DDM may be more realistic than the zero growth DDM in allowing for dividend growth, it assumes that dividends grow by the same specific percentage each year. This is also an unrealistic assumption that can present problems when attempting to evaluate companies such as Amazon, Facebook, Google, or other organizations that do not pay dividends. Constant growth models are most often used to value mature companies whose dividend payments have steadily increased over a significant period of time. When applied, the constant growth DDM will generate the present value of an infinite stream of dividends that are growing at a constant rate.

The constant growth DDM formula is

$$\text{Stock Value} = \frac{D_0(1 + g)}{r - g} = \frac{D_1}{r - g} \quad \textbf{11.14}$$

where $D_0$ is the value of the dividend received this year, $D_1$ is the value of the dividend to be received next year, $g$ is the growth rate of the dividend, and $r$ is the required rate of return.

As can be seen above, after simplification, the constant growth DDM formula becomes the Gordon growth model formula and works in the same way. Let's look at some examples.

### THINK IT THROUGH

#### Constant Growth DDM: Example 1

If a stock is paying a dividend of $5.00 this year and the dividend has been steadily growing at 4% annually, what is the intrinsic value of the stock, assuming an investor's required rate of return of 8%?

**Solution:**

Apply the constant growth DDM formula:

$$\text{Stock Value} = \frac{D_0\ (1 + g)}{r - g} = \frac{\$5.00(1 + 0.04)}{0.08 - 0.04} \quad \textbf{11.15}$$

Simplify to the Gordon growth model:

$$D_1 = D_0(1 + g) = \$5.00 \times 1.04 = \$5.20 \quad \textbf{11.16}$$

$$\text{Stock Value} = \frac{D_1}{r - g} = \frac{\$5.20}{0.08 - 0.04} = \$130.00 \quad \textbf{11.17}$$

THINK IT THROUGH

### Constant Growth DDM: Example 2

If a stock is selling at $250 with a current dividend of $10, what would be the dividend growth rate of this stock, assuming a required rate of return of 12%?

**Solution:**

Apply the constant growth DDM formula:

$$\$250 = \frac{\$10 \times (1 + g)}{0.12 - g} \tag{11.18}$$

Simplify and continue the calculation:

$$\begin{aligned} 30 - 250g &= 10 + 10g \\ 0 &= 10 + 260g \\ 20 &= 260g \\ 7.69\% &= g \end{aligned} \tag{11.19}$$

So, the growth rate is 7.69%.

LINK TO LEARNING

### Dividend Discount Model: A Complete Animated Guide

In this video for the Investing for Beginners course and podcast, Andrew Sather introduces the DDM, (https://openstax.org/r/Andrew_Sather_introduces_the_DDM) demonstrating both the constant growth DDM (Gordon growth model) and the two-stage DDM.

## Variable or Nonconstant Growth Dividend Discount Model

Many experienced analysts prefer to use the variable (nonconstant) growth DDM because it is a much closer approximation of businesses' actual dividend payment policies, making it much closer to reality than other forms of DDM. The variable growth model is based on the real-life assumption that a company and its stock value will progress through different stages of growth.

The variable growth model is estimated by extending the constant growth model to include a separate calculation for each growth period. Determine present values for each of these periods, and then add them all together to arrive at the intrinsic value of the stock. The variable growth model is more involved than other DDM methods, but it is not overly complex and will often provide a more realistic and accurate picture of a stock's true value.

As an example of the variable growth model, let's say that Maddox Inc. paid $2.00 per share in common stock dividends last year. The company's policy is to increase its dividends at a rate of 5% for four years, and then the growth rate will change to 3% per year from the fifth year forward. What is the present value of the stock if the required rate of return is 8%? The calculation is shown in Table 11.1.

| Year | Growth % | Dividend ($) | Value after Year 4 ($) | PV Discount Factor at 8% | Present Value of Dividend ($) |
|---|---|---|---|---|---|
| 0 | 5% | 2.00 | | | |
| 1 | 5% | 2.10 | | 1.0800 | 1.9444 |
| 2 | 5% | 2.21 | | 1.1664 | 1.8904 |
| 3 | 5% | 2.32 | | 1.2597 | 1.8379 |
| 4 | 5% | 2.43 | | 1.3605 | 1.7869 |
| 5 | 3% | 2.50 | 50.07886 | 1.4693 | 35.7870 |
| | | | | | **Total: $43.2466** |

**Table 11.1 Value of Stock with 8% Required Rate of Return**

Note:

$$\text{Value after Year 4} = \frac{2.4310125 \times 1.03}{0.08 - 0.03} = 50.078858 \quad \textbf{11.20}$$

The value of Maddox stock in this example would be $43.25 per share.

## Two-Stage Dividend Discount Model

The two-stage DDM is a methodology used to value a dividend-paying stock and is based on the assumption of two primary stages of dividend growth: an initial period of higher growth and a subsequent period of lower, more stable growth.

The two-stage DDM is often used with mature companies that have an established track record of making residual cash dividend payments while experiencing moderate rates of growth. Many analysts like to use the two-stage model because it is reasonably grounded in reality. For example, it is probably a more reasonable assumption that a firm that had an initial growth rate of 10% might see its growth drop to a more modest level of, say, 5% as the company becomes more established and mature, rather than assuming that the firm will maintain the initial growth rate of 10%. Experts tend to agree that firms that have higher payout ratios of dividends may be well suited to the two-stage DDM.

As we have seen, the assumptions of the two-stage model are as follows:

- The first period analyzed will be one of high initial growth.
- This stage of higher growth will eventually transition into a period of more mature, stable, and sustainable growth at a lower rate than the initial high-growth period.
- The dividend payout ratio will be based on company performance and the expected growth rate of its operations.

Let's use an example. Lore Ltd. estimates that its dividend growth will be 13% per year for the next five years. It will then settle to a sustainable, constant, and continuing rate of 5%. Let's say that the current year's dividend is $14 and the required rate of return (or discount rate) is 12%. What is the current value of Lore Ltd. stock?

**Step 1:**

First, we will need to calculate the dividends for each year until the second, stable growth rate phase is reached. Based on the current dividend value of $14 and the anticipated growth rate of 13%, the values of dividends ($D_1$, $D_2$, $D_3$, $D_4$, $D_5$) can be determined for each year of the first phase. Because the stable growth rate is achieved in the second phase, after five years have passed, if we assume that the current year is 2021, we can lay out the profile for this stock's dividends through the year 2026, as per Figure 11.3.

| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| 1 | Step 1 | | | | | | |
| 2 | | Current | | | | | |
| 3 | | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 |
| 4 | | | | | | | |
| 5 | Dividend at 13% Growth | 14.00 | 15.82 | 17.88 | 20.20 | 22.83 | 25.79 |
| 6 | | | | | | | |
| 7 | Growth Rate of Dividends | N/A | 13% | 13% | 13% | 13% | 13% |

**Figure 11.3 Profile of Stock Dividend through 2026**

**Step 2:**

Next, we apply the DDM to determine the terminal value, or the value of the stock at the end of the five-year high-growth phase and the beginning of the second, lower growth-phase.

We can apply the DDM formula at any point in time, but in this example, we are working with a stock that has constant growth in dividends for five years and then decreases to a lower growth rate in its secondary phase. Because of this timing and dividend structure, we calculate the value of the stock five years from now, or the terminal value. Again, this is calculated at the end of the high-growth phase, in 2026. By applying the constant growth DDM formula, we arrive at the following:

$$\text{Stock Value}_N = \frac{D_N(1+g)}{r-g} = \frac{D_{N+1}}{r-g} \quad \textbf{11.21}$$

The terminal value can be calculated by applying the DDM formula in Excel, as seen in Figure 11.4 and Figure 11.5. The terminal value, or the value at the end of 2026, is $386.91.

| | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| 9 | Step 2A | | | | | | | |
| 10 | | Current | | | | | | |
| 11 | | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 |
| 12 | | | | | | | | |
| 13 | Dividend at 13% Growth | 14.00 | 15.82 | 17.88 | 20.20 | 22.83 | 25.79 | **27.08** |
| 14 | | | | | | | | |
| 15 | Growth Rate of Dividends | N/A | 13% | 13% | 13% | 13% | 13% | 5% |
| 16 | Terminal Value | | | | | | **=H13/(B17-H15)** | |
| 17 | Required Rate of Return | **0.12** | | | | | | |

**Figure 11.4 Terminal Value at the End of 2026 (Showing Formula)**

| | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| 19 | Step 2B | | | | | | | |
| 20 | | Current | | | | | | |
| 21 | | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 |
| 22 | | | | | | | | |
| 23 | Dividend at 13% Growth | 14.00 | 15.82 | 17.88 | 20.20 | 22.83 | 25.79 | 27.08 |
| 24 | | | | | | | | |
| 25 | Growth Rate of Dividends | N/A | 13% | 13% | 13% | 13% | 13% | 5% |
| 26 | **Terminal Value** | | | | | | **386.91** | |
| 27 | **Required Rate of Return** | **0.12** | | | | | | |

**Figure 11.5 Terminal Value at the End of 2026**

**Step 3:**

Next, we find the PV of all paid dividends that occur during the high-growth period of 2022–2026. This is shown in Figure 11.6. Our required rate of return (discount rate) is 12%.

| | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| 29 | Step 3 | | | | | | | |
| 30 | | Current | | | | | | |
| 31 | | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 |
| 32 | | | | | | | | |
| 33 | Dividend at 13% Growth | 14.00 | 15.82 | 17.88 | 20.20 | 22.83 | 25.79 | 27.08 |
| 34 | | | | | | | | |
| 35 | Growth Rate of Dividends | N/A | 13% | 13% | 13% | 13% | 13% | 5% |
| 36 | Terminal Value | | | | | | 386.91 | |
| 37 | Required Rate of Return | 0.12 | | | | | | |
| 38 | | | | | | | | |
| 39 | **Present Value of Dividends** | **N/A** | **14.13** | **14.25** | **14.38** | **14.51** | **14.64** | |

**Figure 11.6 Present Value of All Paid Dividends, 2022–2026**

**Step 4:**

Next, we calculate the PV of the single lump-sum terminal value:

$$\begin{aligned} &\text{Future Value (FV)} = 386.91 \\ &\text{Interest Rate (I/Y)} = 12 \\ &\text{Number of Periods (N)} = 5 \\ &\text{Payment (PMT)} = 0 \\ &\text{Compute Present Value (CPTPV)} = 219.54 \end{aligned} \quad \textbf{11.22}$$

Remember that due to the sign convention, either the FV must be entered as a negative value or, if entered as a positive value, the resulting PV will be negative. This example shows the former.

**Step 5:**

Our next step is to find the current fair (intrinsic) value of the stock, which comprises the PV of all future dividends plus the PV of the terminal value. This is represented in the following formula, with all factors shown in Figure 11.7:

$$\text{Fair Value} = \text{PV}_{\text{Projected Dividends}} + \text{PV}_{\text{Terminal Value}} \quad \textbf{11.23}$$

| | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| 42 | Step 5 | | | | | | | | |
| 43 | | Current | | | | | | | |
| 44 | | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | |
| 45 | | | | | | | | | |
| 46 | Dividend at 13% Growth | 14.00 | 15.82 | 17.88 | 20.20 | 22.83 | 25.79 | 27.08 | |
| 47 | | | | | | | | | |
| 48 | Growth Rate of Dividends | N/A | 13% | 13% | 13% | 13% | 13% | 5% | |
| 49 | Terminal Value | | | | | | 386.91 | | |
| 50 | Required Rate of Return | 0.12 | | | | | | | |
| 51 | | | | | | | | | |
| 52 | **Present Value of Dividends** | **N/A** | **14.13** | **14.25** | **14.38** | **14.51** | **14.64** | | **71.90** |
| 53 | | | | | | | | | |
| 54 | **Present Value of Terminal Value** | | | | | | **219.54** | | **219.54** |
| 55 | | | | | | | | | |
| 56 | | | | | | **Fair Value** | | | **291.44** |

**Figure 11.7 Fair Value of the Stock**

So, we end up with a total current fair value of Lore Ltd. stock of $291.44 (due to Excel's rounding), although the sum can also be calculated as shown below:

$$\text{Fair Value} = 14.13 + 14.25 + 14.38 + 14.51 + 14.64 + 219.54 = 291.45 \quad \textbf{11.24}$$

LINK TO LEARNING

Determining Stock Value

Take a few minutes to review this video, which covers methods used to determine stock value (https://openstax.org/r/covers_methods_used_to_determine_stock_value) when dividend growth is nonconstant.

## Advantages and Limitations of DDMs

Some of the primary advantages of DDMs are their basis in the sound logic of present value concepts, their consistency, and the implication that companies that pay dividends tend to be mature and stable entities. Also, because the model is essentially a mathematical formula, there is little room for misinterpretation or subjectivity. As a result of these advantages, DDMs are a very popular form of stock evaluation that most analysts show faith in.

Because dividends are paid in cash, companies may keep making their dividend payments even when doing so is not in their best long-term interests. They may not want to manipulate dividend payments, as this can directly lead to stock price volatility. Rather, they may manipulate dividend payments in the interest of buoying up their stock price.

To further illustrate limitations of DDMs, let's examine the Concepts in Practice case.

CONCEPTS IN PRACTICE

Limitations of DDMs

A major limitation of the dividend discount model is that it cannot be used to value companies that do not pay dividends. This is becoming a growing trend, particularly for young high-tech companies. Warren Buffett, CEO of Berkshire Hathaway, has stated that companies are usually better off if they take their excess funds and reinvest them into infrastructure, evolving technologies, and other profitable ventures. The payment of dividends to shareholders is "almost a last resort for corporate management,"[1] says Buffett, and cash balances should be invested in "projects to become more efficient, expand territorially, extend and improve product lines or . . . otherwise widen the economic moat separating the company from its competitors."[2] Berkshire follows this practice of reinvesting cash rather than paying dividends, as do tech companies such as Amazon, Google, and Biogen.[3] So, rather than receiving cash dividends, stockholders of these companies are rewarded by seeing stock price appreciation in their investments and ultimately large capital gains when they finally decide to sell their shares.

The sensitivity of assumptions is also a drawback of using DDMs. The fair price of a stock can be highly sensitive to growth rates and the required rates of return demanded by investors. A single percentage point change in either of these two factors can have a dramatic impact on a company's stock, potentially changing it by as much as 10 to 20%.

1 Dan Caplinger. "Why Don't These Winning Stocks Pay Dividends?" The Motley Fool. Updated October 3, 2018. https://www.fool.com/investing/general/2015/03/01/why-dont-these-winning-stocks-pay-dividends.aspx
2 The Motley Fool. "Why Warren Buffet's Berkshire Hathaway Won't Pay a Dividend in 2015." Nasdaq. November 16, 2014. https://www.nasdaq.com/articles/why-warren-buffetts-berkshire-hathaway-wont-pay-dividend-2015-2014-11-16.
3 Caplinger, "Why Don't These Winning Stocks Pay Dividends?" The Motley Fool.

Finally, the results obtained using DDMs may not be related to the results of a company's operations or its profitability. Dividend payments should theoretically be tied to a company's profitability, but in some instances, companies will make misguided efforts to maintain a stable dividend payout even through the use of increased borrowing and debt, which is not beneficial to an organization's long-term financial health.

(sources: www.wallstreetmojo.com/dividend-discount-model/; pages.stern.nyu.edu/~adamodar/pdfiles/valn2ed/ch13d.pdf; www.managementstudyguide.com/disadvantages-of-dividend-discount-model.htm)

## Stock Valuation with Changing Growth Rates and Time Horizons

Before we move on from our discussion of dividend discount models, let's work through some more examples of how the DDM can be used with a number of different scenarios, changing growth rates, and time horizons.

As we have seen, the value or price of a financial asset is equal to the present value of the expected future cash flows received while maintaining ownership of the asset. In the case of stock, investors receive cash flows in the form of dividends from the company, plus a final payout when they decide to relinquish their ownership rights or sell the stock.

Let's look at a simple illustration of the price of a single share of common stock when we know the future dividends and final selling price.

**Problem:**

Steve wants to purchase shares of Old Peak Construction Company and hold these common shares for five years. The company will pay $5.00 annual cash dividends per share for the next five years.

At the end of the five years, Steve will sell the stock. He believes that he will be able to sell the stock for $25.00 per share. If Steve wants to earn 10% on this investment, what price should he pay today for this stock?

**Solution:**

The current price of the stock is the discounted cash flow that Steve will receive over the next five years while holding the stock. If we let the final price represent a lump-sum future value and treat the dividend payments as an annuity stream over the next five years, we can apply the time value of money concepts we covered in earlier chapters.

**Method 1: Using an Equation**

$$\begin{aligned} \text{Price} &= \text{Future Price} \times \frac{1}{(1+r)^n} + \text{Dividend Stream} \times \frac{\left[1 - \frac{1}{(1+r)^n}\right]}{r} \\ &= \$25.00 \times \frac{1}{(1+0.10)^5} + \$5.00 \times \frac{\left[1 - \frac{1}{(1+0.10)^5}\right]}{0.10} \\ &= \$25.00 \times 0.6209 + \$5.00 \times 3.7908 \\ &= \$15.52 + \$18.95 = \$34.47 \end{aligned} \qquad \textbf{11.25}$$

**Method 2: Using a Financial Calculator**

We can also use a calculator or spreadsheet to find the price of the stock (see Table 11.2).

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 1 | Clear calculator register | CE/C | | 0.00 |
| 2 | Enter number of periods (5) | 5 N | N = | 5.00 |
| 3 | Enter rate of return or interest rate (10%) | 10 I/Y | I/Y = | 10.00 |
| 4 | Enter eventual sales price ($25) | 25 FV | FV = | 25.00 |
| 5 | Enter dividend amount ($5) | 5 PMT | PMT = | 5.00 |
| 6 | Compute present value | CPT PV | PV = | – 34.47 |

**Table 11.2 Calculator Steps for Finding the Price of the Stock**[4]

The stock price is calculated as $34.47.

Note that the value given is expressed as a negative value due to the sign convention used by financial calculators. We know the actual stock value is not negative, so we can just ignore the minus sign.

In cases such as the above, we find the present value of a dividend stream and the present value of the lump-sum future price. So, if we know the dividend stream, the future price of the stock, the future selling date of the stock, and the required return, it is possible to price stocks in the same manner that we price bonds.

**Method 3: Using Excel**

Figure 11.8 shows a spreadsheet setup in Excel to reach a solution to this problem.

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | | | | | | |
| 2 | Nper (N) or Number of Periods | | | | | 5 |
| 3 | Rate of Return or Interest Rate | | | | | 10% |
| 4 | Future Value or Stock Sale Price | | | | | $ 25.00 |
| 5 | Payment (Dividend Amount) | | | | | $ 5.00 |
| 6 | | | | | | $ (34.48) |

**Figure 11.8 Excel Solution for Finding the Price of the Stock**

Due to the sign convention in Excel, we can ignore the parentheses around the solution, which indicate a negative value. Therefore, the price is $34.48. The Excel command used in cell F6 to calculate present value is as follows:

```
=PV(rate,nper,pmt,[fv],[type])
```

## Finding Stock Price with Constant Dividends

**Example 1:**

Four Seasons Resorts pays a $0.25 dividend every quarter and will maintain this policy forever. What price should you pay for one share of common stock if you want an annual return of 10% on your investment?

**Solution:**

You can restate your annual required rate of 10% as a quarterly rate of $2.5\%$ $\left(\frac{10\%}{4}\right)$. Apply the quarterly dividend amount and the quarterly rate of return to determine the price:

4 The specific financial calculator in these examples is the Texas Instruments BA II Plus™ Professional model, but you can use other financial calculators for these types of calculations.

$$\text{Price} = \frac{\text{Dividend}}{r} \qquad \text{Price} = \frac{\$0.25}{0.025} = \$10.00 \tag{11.26}$$

Even though we anticipate that companies will be in business "forever," we are not going to own a company's stock forever. Therefore, the dividend stream to which we would have legal claim is only for that period of the company's life during which we own the stock. We need to modify the dividend model to account for a finite period when we will sell the stock at some future time. This modification brings us from an infinite to a finite dividend pricing model, which we will use to price a finite amount of dividends and the future selling price of the stock. We will maintain a constant dividend assumption. Let's assume we will hold a share in a company that pays a $1 dividend for 20 years and then sell the stock.

**Method 1: Using an Equation**

The dividend pricing model under a finite horizon is a concept we have seen earlier. It is a simple present value annuity stream application:

$$\text{Value of Future Dividends for Specific Periods} = \text{Dividend} \times \text{PVIFA (Present Value Interest Factor of an Annuity)} \tag{11.27}$$

$$\text{Dividend Stream} \times \frac{\left[1 - \frac{1}{(1+r)^n}\right]}{r} = \$1.00 \times \frac{\left[1 - \frac{1}{(1+0.10)^{20}}\right]}{0.10} \tag{11.28}$$

$$= \$1.00 \times 8.5136 = \$8.51$$

We now need to determine the selling price that we would get in 20 years if we were to sell the stock to someone else at that time. What would a willing buyer give us for the stock 20 years from now? This price is difficult to estimate, so for the sake of this exercise, we will assume that the price in 20 years will be $30. So, what is the present value of the price in 20 years with a 10% discount rate? Again, this is just a simple application of the PV formula we covered earlier in the text:

$$\text{PV} = \frac{\text{Price}_{20}}{(1+r)^{20}} = \frac{\$30}{(1.10)^{20}} = \$4.46 \tag{11.29}$$

We can now price the stock as if it were a bond with a dividend stream of 20 years, a sales price in 20 years, and a required return of 10%:

- The dividend stream is analogous to the coupon payments.
- The sales price is analogous to the bond's principal.
- The 20-year investment horizon is analogous to the bond's maturity date.
- The required return is analogous to the bond's yield.

Carrying on with the PV calculations, we have

$$\text{Price} = \$30 \times \frac{1}{(1+0.10)^{20}} + \frac{\left[\$1.00 \times 1 - \frac{1}{(1+0.10)^{20}}\right]}{0.10} \tag{11.30}$$

$$= \$4.46 + \$8.51 = \$12.97$$

**Method 2: Using a Financial Calculator**

We can also use a calculator or spreadsheet to find the price of the stock using constant dividends (see Table 11.3).

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 1 | Clear calculator register | CE/C | | 0.00 |
| 2 | Enter number of periods (20) | 20 N | N = | 20.00 |
| 3 | Enter rate of return or interest rate (10%) | 10 I/Y | I/Y = | 10.00 |
| 4 | Enter eventual sales price (30) | 30 FV | FV = | 30.00 |
| 5 | Enter dividend amount ($1) | 1 PMT | PMT = | 1.00 |
| 6 | Compute present value | CPT PV | PV = | −12.97 |

**Table 11.3 Calculator Steps for Finding the Price of Stock Using Constant Dividends**

The stock price resulting from the calculation is $12.97.

**Method 3: Using Excel**

This same problem can be solved using Excel with a setup similar to that shown in Figure 11.9.

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 8 | | | | | | |
| 9 | Nper (N) or Number of Periods | | | | | 20 |
| 10 | Rate of Return or Interest Rate | | | | | 10% |
| 11 | Payment (Dividend Amount) | | | | | $ 1.00 |
| 12 | Future Value or Stock Sale Price | | | | | $ 30.00 |
| 13 | | | | | | $ (12.97) |

**Figure 11.9 Excel Solution for Finding the Price of Stock Using Constant Dividends**

Once again, we can ignore the negative indicator that is generated by the Excel sign convention because we know that the stock will not have a negative value 20 years from now. Therefore, the price is $12.97. The Excel command used in cell F13 to calculate present value is as follows:

```
=PV(rate,nper,pmt,[fv],[type])
```

**Example 2:**

Let's look at an example and estimate current stock price given a 10.44% constant growth rate of dividends forever and a desired return on the stock of 13.5%. We will assume that the current stock owner has just received the most recent dividend, $D_0$, and the new buyer will receive all future cash dividends, beginning with $D_1$. This part of the setup of the model is important because the price reflects all future dividends, starting with $D_1$, discounted back to today. ($\text{Price}_0$ refers to the price at time zero, or today.) The first dividend the buyer would receive is one full period away. Using the discounted cash flow approach, we have

$$\text{Price}_0 = \frac{D_0 \times (1+g)^1}{(1+r)^1} + \frac{D_0 \times (1+g)^2}{(1+r)^2} + \frac{D_0 \times (1+g)^3}{(1+r)^3} + \frac{D_0 \times (1+g)^4}{(1+r)^4} \ldots \quad \textbf{11.31}$$

where $g$ is the annual growth rate of the dividends and $r$ is the required rate of return on the stock. We can simplify the equation above into the following:

$$\begin{aligned} \text{Price}_0 &= \frac{D_0 \times (1+g)}{r-g} \\ D_1 &= D_0 \times (1+g) \\ \text{Price}_0 &= \frac{D_1}{r-g} \end{aligned} \quad \textbf{11.32}$$

As we discussed above, this classic model of constant dividend growth, known as the Gordon growth model, is a fundamental method of stock pricing. The Gordon growth model determines a stock's value based on a future stream of dividends that grows at a constant rate. Again, we assume that this constantly growing dividend stream will pay forever. To see how the constant growth model works, let's use our example from above once again as a test case. The most recent dividend ($D_0$) is \$1.76, the growth rate ($g$) is 10.44%, and the required rate of return ($r$) is 13.5%, so applying our PV equation, we have

$$\text{Price}_0 = \frac{\$1.76 \times (1 + 0.1044)}{0.135 - 0.1044} = \frac{\$1.943774}{0.0306} = \$63.52 \quad \textbf{11.33}$$

Our estimated price for this example is \$63.52. Notice that the formula requires the return rate $r$ to be greater than the growth rate $g$ of the dividend stream. If $g$ were greater than $r$, we would be dividing by a negative number and producing a negative price, which would be meaningless.

Let's pick another company and see if we can apply the dividend growth model and price the company's stock with a different dividend history. In addition, our earlier example will provide a shortcut method to estimate $g$, although you could still calculate each year's percentage change and then average the changes over the 10 years.

## Estimating a Stock Price from a Past Dividend Pattern

**Problem:**

Phased Solutions Inc. has paid the following dividends per share from 2011 to 2020:

| 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|
| \$0.700 | \$0.800 | \$0.925 | \$1.095 | \$1.275 | \$1.455 | \$1.590 | \$1.795 | \$1.930 | \$2.110 |

**Table 11.4**

If you plan to hold this stock for 10 years, believe Phased Solutions will continue this dividend pattern forever, and you want to earn 17% on your investment, what would you be willing to pay per share of Phased Solutions stock as of January 1, 2021?

**Solution:**

First, we need to estimate the annual growth rate of this dividend stream. We can use a shortcut to determine the average growth rate by using the first and last dividends in the stream and the time value of money equation. We want to find the average growth rate given an initial dividend (present value) of \$0.70, the most recent dividend (future value) of \$2.11, and the number of years ($n$) between the two dividends, or the number of dividend changes, which is 9. So, we calculate the average growth rate as follows:

$$\begin{aligned} g &= \left(\frac{\text{FV}}{\text{PV}}\right)^{\frac{1}{n}} - 1 \\ &= \left(\frac{\$2.11}{\$0.70}\right)^{\frac{1}{9}} - 1 = 3.0142857^{\frac{1}{9}} - 1 \\ &= 0.1304, \text{ or } 13.04\% \end{aligned} \quad \textbf{11.34}$$

Table 11.5 shows the step-by-step process of using a financial calculator to solve for the growth rate.

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 1 | Clear calculator register | CE/C | | 0.0000 |
| 2 | Enter number of periods (9) | 9 N | N = | 9.0000 |

**Table 11.5 Calculator Steps for Solving the Growth Rate**

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 3 | Enter present value or initial dividend ($0.70) as a negative value | 0.7 +\|− PV | PV = | -0.7000 |
| 4 | Enter future value or the most recent dividend ($2.11) | 2.11 FV | FV = | 2.1100 |
| 5 | Enter a zero value for payment as a placeholder, as this factor is not used here | 0 PMT | PMT | 0.0000 |
| 6 | Compute annual growth rate | CPT I/Y | I/Y = | 13.0427 |

**Table 11.5 Calculator Steps for Solving the Growth Rate**

The calculated growth rate is 13.04%.

We can also use Excel to set up a spreadsheet similar to the one in Figure 11.10 that will calculate this growth rate.

| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| 15 | | | | | | | |
| 16 | | | | | | | |
| 17 | Present Value or Current Dividend Amount (enter as a negative value) | | | | | | $ (0.70) |
| 18 | Nper (N) or Number of Periods | | | | | | 9 |
| 19 | Payment or PMT (unused here, so enter zero as a placeholder) | | | | | | - |
| 20 | Future Value (dividend amount in nine years) | | | | | 13.04% | $ 2.11 |
| 21 | | | | | | | |
| 22 | Growth Rate | | | | | | 13.0427% |

**Figure 11.10 Excel Solution for Growth Rate**

The Excel command used in cell G22 to calculate the growth rate is as follows:

```
=RATE(nper,pmt,pv,[fv],[type],[guess])
```

We now have two methods to estimate *g*, the growth rate of the dividends. The first method, calculating the change in dividend each year and then averaging these changes, is the arithmetic approach. The second method, using the first and last dividends only, is the geometric approach. The arithmetic approach is equivalent to a simple interest approach, and the geometric approach is equivalent to a compound interest approach.

To apply our PV formula above, we had to assume that the company would pay dividends forever and that we would hold on to our stock forever. If we assume that we will sell the stock at some point in the future, however, can we use this formula to estimate the value of a stock held for a finite period of time? The answer is a qualified yes. We can adjust this model for a finite horizon to estimate the present value of the dividend stream that we will receive while holding the stock. We will still have a problem estimating the stock's selling price at the end of this finite dividend stream, and we will address this issue shortly. For the finite growing dividend stream, we adjust the infinite stream in our earlier equation to the following:

$$\text{Price}_0 = D_0 \times \frac{1+g}{r-g} \times \left[1 - \left(\frac{1+g}{1+r}\right)^n\right] \quad \textbf{11.35}$$

where *n* is the number of future dividends.

This equation may look very complicated, but just focus on the far right part of the model. This part calculates the percentage of the finite dividend stream that you will receive if you sell the stock at the end of the *n*th year. Say you will sell Johnson & Johnson after 10 years. What percentage of the $60.23 (the finite dividend stream) will you get? Begin with the following:

$$10 \text{ Years: Percent} = 1 - \left(\frac{1 + 0.1304}{1 + 0.170}\right)^{10} \quad \textbf{11.36}$$
$$= 1 - 0.966154^{10} \;=\; 1 - 0.7087 = 0.2913$$

Now, multiply the result by the price for your portion of the infinite stream:

$$\text{Price} = \$60.23 \times 0.2913 \;=\; \$17.55 \quad \textbf{11.37}$$

The next step is to discount the selling price of Johnson & Johnson in 10 years at 17% and then add the two values to get the stock's price. So, how do we estimate the stock's price at the end of 10 years? If we elect to sell the stock after 10 years and the company will continue to pay dividends at the same growth rate, what would a buyer be willing to pay? How could we estimate the selling price (value) of the stock at that time?

We need to estimate the dividend in 10 years and assume a growth rate and the required return of the new owner at that point in time. Let's assume that the new owner also wants a 17% return and that the dividend growth rate will remain at 13.04%. We calculate the dividend in 10 years by taking the current growth rate plus one raised to the tenth power times the current dividend:

$$D_{10} = \$2.11 \times (1.1304)^{10} = \$2.11 \times 3.4066 = \$7.1879 \quad \textbf{11.38}$$

We then use the dividend growth model with infinite horizon to determine the price in 10 years as follows:

Your price for the stock today—given that you will receive the growing dividend stream for 10 years and sell for $258.10 in 10 years, and also given that you want a 17% return over the 10 years—is as shown below:

$$\text{Price} = \frac{\$205.18}{(1.1700)^{10}} + \frac{\$2.11 \times (1 + 0.1304)}{(0.1700 - 0.1304)} \times \left[1 - \left(\frac{1 + 0.1304}{1 + 0.1700}\right)^{10}\right] \quad \textbf{11.39}$$
$$= \$42.68 + \$17.55 \;=\; \$60.23$$

Why did you get the same price of $60.23 for your stock with both the infinite growth model and the finite model? The reason is that the required rate of return of the stock remained at 17% (your rate) and the growth rate of the dividends remained at 13.04%. The infinite growth model gives the same price as the finite model with a future selling price as long as the required return and the growth rate are the same for all future sales of the stock.

Although this point may be subtle, what we have just shown is that a stock's price is the present value of its future dividend stream. When you sell the stock, the buyer purchases the remaining dividend stream. If that individual should sell the stock in the future, the new owner would buy the remaining dividends. That will always be the case; a stock's buyer is always buying the future dividend stream.

## LINK TO LEARNING

### Determining Stock Value Using Different Scenarios

This video explains methods for determining stock value (https://openstax.org/r/explains_methods_for_determining_stock_value) using scenarios of constant dividends and scenarios of constant dividend growth.

## THINK IT THROUGH

### Nonconstant Growth Dividends

One final issue to address in this section is how we price a stock when dividends are neither constant nor growing at a constant rate. This can make things a bit more complicated. When a future pattern is not an annuity or the modified annuity stream of constant growth, there is no shortcut. You have to estimate every

future dividend and then discount each individual dividend back to the present. All is not lost, however. Sometimes you can see patterns in the dividends. For example, a firm might shift into a dividend stream pattern that will allow you to use one of the dividend models to take a shortcut for pricing the stock. Let's look at an example.

JM and Company is a small start-up firm that will institute a dividend payment—a $0.25 dividend—for the first time at the end of this year. The company expects rapid growth over the next four years and will increase its dividend to $0.50 at the end of the second year, then to $1.50 at the end of the third year, and then to $3.00 thereafter, settling into a constant growth dividend pattern with dividends growing at 5% every year (see Table 11.6). If you believe that JM and Company will deliver this dividend pattern and you desire a 13% return on your investment, what price should you pay for this stock?

| T1 | T2 | T3 | T4 |
|---|---|---|---|
| $0.25 | $0.50 | $1.50 | $3.00 × 1.05 |

**Table 11.6**

**Solution:** To price this stock, we will need to discount the first three dividends at 13% and then discount the constant growth portion of the dividends, the first payment of which will be received at the end of the 6th year. Let's calculate the first three dividends:

$$\begin{aligned} \text{PV} &= \frac{\$0.25}{1.13} + \frac{\$0.50}{1.13} + \frac{\$1.50}{1.13} \\ &= \$0.22 + \$0.39 + \$1.04 = \$1.65 \end{aligned} \quad \textbf{11.40}$$

We now turn to the constant growth dividend pattern, where we can use our infinite horizon constant growth model as follows:

$$\text{Price}_6 = \frac{\$3.00 \times (1 + 0.05)}{0.13 - 0.05} = \frac{\$3.15}{0.08} = \$39.375 \quad \textbf{11.41}$$

This figure is the price of the constant growth portion at the end of the fourth period, so we still need to discount it back to the present at the 13% required rate of return:

$$\text{Price} = \frac{\$39.375}{(1.13)^4} = \$24.15 \quad \textbf{11.42}$$

So, the price of this stock with a nonconstant dividend pattern is

$$\text{Price} = \$1.65 + \$24.15 = \$25.80 \quad \textbf{11.43}$$

## Some Final Thoughts on Dividend Discount Models

The dividend used to calculate a price is the expected future payout and expected future dividend growth. This means the DDM is most useful when valuing companies that have long, consistent dividend records.

If the DDM formula is applied to a company with a limited dividend history, or in an industry exposed to significant risks that could affect a company's ability to maintain its payout, the resulting derived value may not be entirely accurate.

In most cases, dividend models, whether constant growth or constant dividend, appeal to a fundamental concept of asset pricing: the future cash flow to which the owner is entitled while holding the asset and the required rate of return for that cash flow determine the value of a financial asset. However, problems can arise when using these models because the timing and amounts of future cash flows may be difficult to predict.

# 11.3 Discounted Cash Flow (DCF) Model

## Learning Outcomes

By the end of this section, you will be able to:

- Explain how the DCF model differs from DDMs.
- Apply the DCF model.
- Explain the advantages and disadvantages of the DCF model.

When investors buy stock, they do so in order to receive cash inflows at different points in time in the future. These inflows come in the form of cash dividends (provided the stock does indeed pay dividends, because not all do) and also in the form of the final cash inflow that will occur when the investor decides to sell the stock.

The investor hopes that the final sale price of the stock will be higher than the purchase price, resulting in a capital gain. The hope for capital gains is even stronger in the case of stocks that do not pay dividends. When securities have been held for at least one year, the seller is eligible for long-term capital gains tax rates, which are lower than short-term rates for most investors. This makes non-dividend-paying stocks even more attractive, provided that they do indeed appreciate in value over the investor's holding period. Meanwhile, short-term gains, or gains made on securities held for less than one year, are taxed at ordinary income tax rates, which are usually higher and offer no particular advantage to an investor in terms of reducing their taxes.

## Understanding How the DCF Model Differs from DDMs

The valuation of an asset is typically based on the present value of future cash flows that are generated by the asset. It is no different with common stock, which brings us to another form of stock valuation: the **discounted cash flow (DCF)** model. The DCF model is usually used to evaluate firms that are relatively young and do not pay dividends to their shareholders. Examples of such companies include Facebook, Amazon, Google, Biogen, and Monster Beverage. The DCF model differs from the dividend discount models we covered earlier, as DDM methodologies are almost entirely based on a stock's periodic dividends.

The DCF model is an absolute valuation model, meaning that it does not involve comparisons with other firms within any specific industry but instead uses objective data to evaluate a company on a stand-alone basis. The DCF model focuses on a company's cash flows, determining the present value of the entire organization and then working this down to the share-value level based on total shares outstanding of the subject organization. This highly regarded methodology is the evaluation tool of choice for experienced financial analysts when evaluating companies and their common stock. Many analysts prefer DCF methods of valuation because these are based on a company's cash flows, which are far less easily manipulated through accounting treatments than revenues or bottom-line earnings.

The DCF model formula in its mathematical form is presented below:

$$\text{Stock Value} = \frac{\text{CF}_1}{(1+r)^1} + \frac{\text{CF}_2}{(1+r)^2} + \ldots + \frac{\left(\frac{\text{TCF}}{r-g}\right)}{(1+r)^{n-1}} \qquad \textbf{11.44}$$

where $\text{CF}_1$ is the estimated cash flow in year 1, $\text{CF}_2$ is the estimated cash flow in year 2, and so on; TCF is the terminal cash flow, or expected cash flow from the ending asset sale; $r$ is the discount rate or required rate of return; $g$ is the anticipated growth rate of the cash flow; and $n$ is the number of years covered in the model.

## Applying the DCF Model

We can apply the DCF model to an example to demonstrate this methodology and how the formula works. Calculate the value of Mayweather Inc. and its common stock based on the next six years of cash flow results. Assume that the discount rate (required rate of return) is 8%, Mayweather's growth rate is 3%, and the terminal value (TCF) will be two and one-half times the discounted value of the cash flow in year 6.

Mayweather has a cash flow of $2.0 million in year 1, so its discounted cash flow after one year ($CF_1$) is $1,851,851.85. We arrive at this amount by applying the discount rate of 8% for a one-year period to determine the present value.

In subsequent years, Mayweather's cash flow will be increasing by 3%. These future cash flows also must be discounted back to present values at an 8% rate, so the discounted cash flow amounts over the next six years will be as follows:

$$\text{Year 1: \$1,851,852} \tag{11.45}$$

$$\text{Year 2: \$1,766,118} \tag{11.46}$$

$$\text{Year 3: \$1,684,353} \tag{11.47}$$

$$\text{Year 4: \$1,606,374} \tag{11.48}$$

$$\text{Year 5: \$1,532,005} \tag{11.49}$$

$$\text{Year 6: \$1,461,079} \tag{11.50}$$

Our earlier assumption that the terminal value will be 2.5 times the value in the sixth year gives us a total terminal cash flow (TCF) of $\$1{,}461{,}079 \times 2.5$, or $3,652,697. Now, if we take all these future discounted cash flows and add them together, we arrive at a grand total of $13,554,477. So, based on our DCF model analysis, the total value of Mayweather Inc. is just over $13.5 million.

At this point, we have the estimated value of the entire company, but we need to work this down to the level of per-share value of common stock.

Let's say that Mayweather is currently trading at $12 per share, and it has 1,000,000 common shares outstanding. This tells us that the market capitalization of the company is $\$12 \times 1{,}000{,}000$, or $12 million, and that a $12 share price may be considered relatively low. The reason for this is that based on our DCF model analysis, investors would theoretically be willing to pay $13,554,477 divided by 1,000,000 shares, or $13.55 per share, for Mayweather. The overall conclusion would be that at $12.00 per share, Mayweather common stock would be a good buy at the present time. Figure 11.11 shows the Excel spreadsheet approach for arriving at the total value of Mayweather.

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | | | | | |
| 2 | Discount Rate = | | 8.00% | | |
| 3 | | | | | |
| 4 | | Year | Cash Flow | Present Value | |
| 5 | | | | | |
| 6 | CF | 1 | 2,000,000 | **1,851,852** | **=-PV($C$2,B6,0,C6)** |
| 7 | CF | 2 | 2,060,000 | 1,766,118 | |
| 8 | CF | 3 | 2,121,800 | 1,684,353 | |
| 9 | CF | 4 | 2,185,454 | 1,606,374 | |
| 10 | CF | 5 | 2,251,018 | 1,532,005 | |
| 11 | CF | 6 | 2,318,548 | 1,461,079 | |
| 12 | | | | | |
| 13 | Totals | | $ 12,936,820 | 9,901,780 | |
| 14 | TCF | | | 3,652,697 | |
| 15 | Grand Total | | | **$13,554,477** | |

**Figure 11.11 Excel Solution for Total Value**

Cell E6 displays the present value formula that is active in cell D6.

## Advantages and Limitations of the DCF Model

Due to several corporate accounting scandals in recent years, many analysts have given increasing credence to the use of cash flow as a metric for determining accurate corporate valuations. However, it should be noted that cash flow is not always the best means of measuring financial health. A company can always sell a large portion of its assets to generate a positive cash flow, even if it is operating at a loss or experiencing other financial difficulties. Additionally, investors prefer to see companies reinvesting their cash back into their businesses rather than sitting on excessive balances of idle cash.

Similar to other models, the discounted cash flow model is only as good as the information entered. As the common expression goes, "garbage in, garbage out." This can often be the case if reasonably accurate cash flow estimates are not available or if an unrealistic discount rate or required rate of return is used in the calculations. It is always best to use several different methods when valuing companies and their common stock.

LINK TO LEARNING

Discounted Cash Flow

Please view this short video on discounted cash flow (https://openstax.org/r/short_video_on_discounted) and how this method can be applied in stock valuation.

# 11.4 Preferred Stock

### Learning Outcomes

By the end of this section, you will be able to:

- Define preferred stock.
- Calculate the intrinsic value of preferred stock.
- Understand the difference between common stock and preferred stock.

## Features of Preferred Stock

**Preferred stock** is a unique form of equity sold by some firms that offers preferential claims in ownership. Preferred stock will often feature a dividend that a company is obligated to pay out before it makes any dividend payments to common stockholders. In cases of bankruptcy and liquidation of the issuing company, preferred stockholders have priority claim to assets before common stockholders. Additionally, preferred stockholders are usually entitled to a set (or constant) dividend every period.

Preferred stock carries a stated par value, but unlike bonds, they have no maturity date, and consequently, there is no final payment of the par value. The only time a company would pay this par value to the shareholder would be if the company ceased operations or retired the preferred stock. Many preferred stock issues are cumulative in nature, meaning that if a company skips or is otherwise unable to pay a cash dividend, it becomes a liability to the company and must eventually be paid out to preferred shareholders at some point in the future. Other preferred stocks may be noncumulative, in which case if the company skips dividends, they are forever lost to the shareholder.

The term *preferred* comes from preferred shareholders receiving all past (if cumulative) and present dividends before common shareholders receive any cash dividends. In other words, preferred shareholders' dividend claims are given preferential treatment over those of common shareholders. Preferred stock is usually a form of permanent funding, but there are circumstances or covenants that could alter the payoff stream.

For example, a company may convert preferred stock into common stock at a preset point in the future. It is not uncommon for companies to issue preferred stock that has a conversion feature. Such conversion features give preferred shareholders the right to convert to common shares after a predetermined period.

A review of the characteristics of preferred stock will lead to the conclusion that the constant growth dividend model is an excellent approach for valuing such stock. Because shares of preferred stock provide a constant cash dividend based on original par value and the stated dividend rate, these may be considered a form of perpetuity.

It is this constant, preferred dividend stream that makes preferred stock seem more like bonds or another form of debt than like stock. In addition, the constant dividend stream leads nicely to the pricing of preferred stock with the four dividend models we presented earlier in this chapter.

## Determining the Intrinsic Value of Preferred Stock

We can apply a version of the present value of a perpetuity formula to value preferred stock, as in the following example. Oh-Well Heath Services Inc. has issued preferred stock that has a par value of $1,000 and pays an annual dividend rate of 5%. If the market considers the risk of Oh-Well to warrant a 10% discount rate, what would be a fair market price for Oh-Well preferred stock?

First, we find the dividend value of Oh-Well:

$$\begin{aligned} \text{Dividend Dollar Value} &= \text{Par Value} \times \text{Annual Dividend Rate} \\ &= \$1{,}000 \times 0.05 \\ &= \$50 \end{aligned} \tag{11.51}$$

We then use the constant dividend model with infinite horizon because we have $g$ equal to zero and $n$ equal to infinity:

$$\begin{aligned} \text{Stock Value} &= \frac{\text{Dividend}}{\text{Discount Rate}} \\ &= \frac{\$50}{.10} \\ &= \$500 \end{aligned} \tag{11.52}$$

We can also rearrange the formula to determine the required return on this stock, given its annual dividend and current price.

### THINK IT THROUGH

#### Calculating the Return on Preferred Stock

Data Forge Inc. has just issued preferred stock (cumulative) with a par value of $100.00 and an annual dividend rate of 7%. The preferred stock is currently selling for $35.00 per share. What is the yield or return on this preferred stock?

**Solution:**

The first step is to determine the annual dividend by multiplying the dividend rate by the par value:

$$\$100 \times 0.07 = \$7.00 \tag{11.53}$$

Now, using this $7.00 annual dividend, the $35.00 current price, and the equation above, we calculate the rate of return as follows:

$$r = \frac{\$7.00}{\$35.00} = 0.20 \text{ or } 20\% \tag{11.54}$$

We have introduced the concept of return here, which should be thought of as both the anticipated return for the preferred stockholder and the company's cost of borrowing money for this particular type of capital.

## Differences between Preferred and Common Stock

As we have discussed, preferred stock has important differences from common stock that apply to issuing firms and to investors. Some of the most important of these differences are listed in Table 11.7.

| Feature | Common Stock | Preferred Stock |
|---|---|---|
| Dividends | Paid only after preferred stockholders are paid | Highest priority, paid first |
| Dividends | Variable and may increase or decrease | Predetermined rates, so constant dividend amounts |
| Growth | High potential but tied to company performance | |
| Liquidation | Paid out last, after all creditors and preferred stockholders are paid | Given preference in terms of payments, similar to bonds |
| Voting Rights | Yes | No |
| Arrears | No accrual of missed dividends | If cumulative, unpaid dividends become liability that must be paid out eventually |
| Certainty | Dividends potentially not paid if company earns no profits | Dividends paid even when company experiences financial losses |

**Table 11.7 Differences between Common Stock and Preferred Stock**

# 11.5 Efficient Markets

### Learning Outcomes

By the end of this section, you will be able to:

- Understand what is meant by the term *efficient markets*.
- Understand the term *operational efficiency* when referring to markets.
- Understand the term *informational efficiency* when referring to markets.
- Distinguish between strong, semi-strong, and weak levels of efficiency in markets.

## Efficient Markets

For the public, the real concern when buying and selling of stock through the stock market is the question, "How do I know if I'm getting the best available price for my transaction?" We might ask an even broader question: Do these markets provide the best prices and the quickest possible execution of a trade? In other words, we want to know whether markets are efficient. By **efficient markets**, we mean markets in which costs are minimal and prices are current and fair to all traders. To answer our questions, we will look at two forms of efficiency: operational efficiency and informational efficiency.

## Operational Efficiency

Operational efficiency concerns the speed and accuracy of processing a buy or sell order at the best available price. Through the years, the competitive nature of the market has promoted operational efficiency.

In the past, the **NYSE (New York Stock Exchange)** used a designated-order turnaround computer system known as SuperDOT to manage orders. SuperDOT was designed to match buyers and sellers and execute trades with confirmation to both parties in a matter of seconds, giving both buyers and sellers the best available prices. SuperDOT was replaced by a system known as the Super Display Book (SDBK) in 2009 and

subsequently replaced by the Universal Trading Platform in 2012.

**NASDAQ** used a process referred to as the small-order execution system (SOES) to process orders. The practice for registered dealers had been for SOES to publicly display all limit orders (orders awaiting execution at specified price), the best dealer quotes, and the best customer limit order sizes. The SOES system has now been largely phased out with the emergence of all-electronic trading that increased transaction speed at ever higher trading volumes.

Public access to the best available prices promotes operational efficiency. This speed in matching buyers and sellers at the best available price is strong evidence that the stock markets are operationally efficient.

## Informational Efficiency

A second measure of efficiency is informational efficiency, or how quickly a source reflects comprehensive information in the available trading prices. A price is efficient if the market has used all available information to set it, which implies that stocks always trade at their fair value (see Figure 11.12). If an investor does not receive the most current information, the prices are "stale"; therefore, they are at a trading disadvantage.

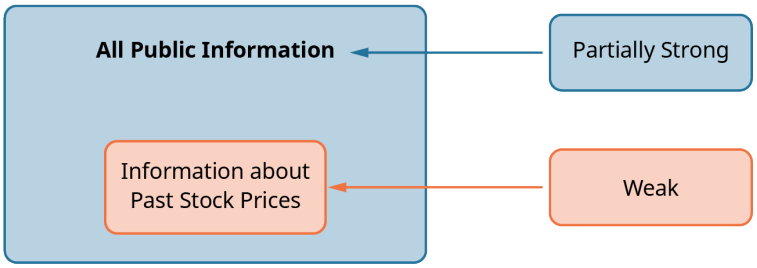


**Figure 11.12 Forms of Market Efficiency** A market is efficient if it provides all information that is available.

## Forms of Market Efficiency

Financial economists have devised three forms of market efficiency from an information perspective: weak form, semi-strong form, and strong form. These three forms constitute the efficient market hypothesis. Believers in these three forms of efficient markets maintain, in varying degrees, that it is pointless to search for undervalued stocks, sell stocks at inflated prices, or predict market trends.

In weak form efficient markets, current prices reflect the stock's price history and trading volume. It is useless to chart historical stock prices to predict future stock prices such that you can identify mispriced stocks and routinely outperform the market. In other words, technical analysis cannot beat the market. The market itself is the best technical analyst out there.

# Summary

## 11.1 Multiple Approaches to Stock Valuation

This section introduced common stock and some of the models and calculation methods used by investors and financial analysts to determine the prices or values of common shares. The most evaluative ratios that can be computed from a company's financial statements include the price-to-earnings (P/E), price-to book (P/B), price-to-sales (P/S), and price-to cash-flow (P/CF) ratios.

## 11.2 Dividend Discount Models (DDMs)

The dividend discount model, or DDM, is a method used to value a stock based on the concept that its worth is the present value of all of its future dividends. The most common DDM is the Gordon growth model, which values stock entirely on expected future dividends. Other techniques include the zero growth DDM, which depends on fixed dividends; the constant growth DDM, which assumes that dividends will grow at a constant rate; and the variable growth or nonconstant growth DDM, which is based on the assumption that stock value will progress through different stages of growth. There is also the two-stage DDM, which is based on the assumption of two stages of dividend growth: an initial period of higher growth and a subsequent period of lower, more stable growth.

## 11.3 Discounted Cash Flow (DCF) Model

Investors buy stock to receive cash inflows at different points in the future. These inflows may come in the form of dividends or a final cash inflow. If the investor chooses to wait for a final cash flow, the hope is that capital gains will be even stronger. The DCF model is usually used to evaluate firms that are relatively young and do not pay dividends to their shareholders. The DCF model focuses on a company's cash flows, determining the present value of an entire organization using objective data and then working this down to the share-value level based on total shares outstanding of the subject organization.

## 11.4 Preferred Stock

Preferred stock is a unique form of equity sold by some firms that offers preferential claims in ownership. Preferred stock carries a stated par value, but unlike bonds, there is no maturity date, and consequently, there is no final payment of the par value. The term *preferred* comes from preferred shareholders receiving all past (if cumulative) and present dividends before common shareholders receive any cash dividends.

## 11.5 Efficient Markets

Efficient markets are markets in which costs are minimal and prices are current and fair to all traders. There are two forms of efficiency: operational efficiency and informational efficiency. Operational efficiency concerns the speed and accuracy of processing a buy or sell order at the best available price. Informational efficiency concerns how quickly a source reflects comprehensive information in the available trading prices. Financial economists have devised three forms of efficient markets from an information perspective: weak form, semi-strong form, and strong form.

# Key Terms

**amortization** the process of spreading business costs in accounting; similar to depreciation, but differs in that it generally refers to intangible assets such as patents or copyrights

**capital employed** also known as funds employed; the total amount of capital used for the acquisition of profits by a firm or on a project

**common stock** a security that represents partial ownership of a corporation

**comparable company analysis (comps)** a method for valuating a company using the metrics of other businesses of similar size in the same industry

**depreciation** the process of spreading business costs in accounting; similar to amortization, but differs in

that it generally refers to fixed, tangible assets such as buildings, machinery, furniture, fixtures, and equipment

**discounted cash flow (DCF)** a method for estimating the value of an investment based on the present value of its expected future cash flows

**dividend** a sum of money paid regularly (typically quarterly) by a company to its shareholders out of its profits or reserves

**dividend discount model (DDM)** a quantitative method for predicting the price of a company's stock based on the theory that its present-day price is worth the sum of all of its future dividend payments when discounted back to their present value

**dividend yield** a financial ratio (dividend/price) that shows how much a company pays out in dividends each year relative to its stock price, expressed as a percentage

**earnings per share (EPS)** the ratio of a company's profits to the outstanding shares of its common stock; serves as an indicator of a company's profitability

**EBIT** short for earnings before interest and taxes; an indicator of a firm's profitability before the effects of interest or taxes; also referred to as operating earnings, operating profit, and profit before interest and tax

**efficient markets** markets in which costs are minimal and prices are current, fair, and reflective of all available relevant information

**enterprise value (EV)** a company's total value; often used as a more comprehensive alternative to equity market capitalization

**enterprise value (EV) multiples** also known as company value multiples; ratios used to determine the overall value of a company and, by extension, the value of its common stock

**equity multiples** metrics that calculate the expected or achieved total return on an initial investment

**Gordon growth model** a methodology used to determine the intrinsic value of a stock based on a future series of dividends that grow at a constant rate

**growth rate** the rate at which the dollar amount of dividends paid on a specific stock holding increases

**intangible assets** assets that are not physical in nature, such as goodwill, brand recognition, and intellectual property (i.e., patents, trademarks, and copyrights)

**intrinsic value** the value of a firm's stock based entirely on internal factors, such as products, management, and the strength of company brands in the marketplace

**market capitalization** the value of a company traded on the stock market, calculated by multiplying the total number of shares by the current share price

**NASDAQ (National Association of Securities Dealers Automated Quotations)** short for National Association of Securities Dealers Automated Quotations; an American stock exchange based in New York City, ranked second behind the New York Stock Exchange in terms of total market capitalization of shares traded

**net book value** also called net asset value (NAV); the total assets of a company minus its total liabilities

**NYSE (New York Stock Exchange)** the world's largest stock exchange by market capitalization of its listed companies, based in New York City; often referred to as the "Big Board"

**perpetuity** in terms of investments, an annuity with no end date

**precedent transaction analysis (precedents)** a method for valuating a company in which the price paid for similar companies in the past is considered an indicator of the company's current value

**preferred stock** stock that entitles the holder to a fixed dividend, the payment of which takes priority over payment of common stock dividends

**price-to-book (P/B) ratio** also called the market-to-book (M/B) ratio; a metric used to compare a company's market capitalization, or market value, to its book value

**price-to-cash-flow (P/CF) ratio** a stock valuation indicator or multiple that measures the value of a stock's price relative to its operating cash flow per share

**price-to-earnings (P/E) ratio** a ratio that indicates the dollar amount an investor can expect to invest in a company in order to receive one dollar of that company's earnings

**price-to-sales (P/S) ratio** a ratio that indicates how much investors are willing to pay for a company's stock

per dollar of that company's sales

**required return** the minimum return an investor expects to achieve by investing in a project

**secondary markets** markets where investors buy and sell securities they already own

**stock value** also called intrinsic value; the fundamental, objective value of a share of stock

## CFA Institute

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## Multiple Choice

1. The price-to-earnings (P/E) ratio is _____.
   **a.** used to calculate a company's book value
   **b.** a multiplier used in enterprise valuation
   **c.** only applied when valuing preferred stock
   **d.** a metric for showing the expectations of the market

2. The price-to-book (P/B) ratio is also called the _____ ratio.
   **a.** market-to-book
   **b.** enterprise-to-book
   **c.** asset-to-price
   **d.** liability-to-book

3. The two primary types of stock valuation multiples are _____.
   **a.** enterprise value multiples and comparable company value multiples
   **b.** equity multiples and enterprise value multiples
   **c.** asset value multiples and liability value multiples
   **d.** None of the above

4. Dividend yield is a form of equity multiple that is primarily used when _____.
   **a.** the subject company is operating at a loss
   **b.** conducting comparisons between companies in different industries
   **c.** conducting comparisons between cash returns and investment types
   **d.** analyzing mature companies that have been paying dividends for several years

5. Dividend yield is computed as the proportion of dividend per share to _____.
   **a.** share price
   **b.** earnings per share
   **c.** market value per share
   **d.** book value per share

6. Which of the following statements about enterprise value metrics is NOT true?
   **a.** EV to revenue can be used to assess companies with negative cash flows or firms that are currently experiencing financial losses.
   **b.** ROCE is a profitability ratio that measures the return on the equity in a company in comparison to its financing over a short period of time.
   **c.** EBIT allows investors to assess the core operations of the business without worrying about the costs of the capital structure.
   **d.** EBITDAR is a metric that is used in businesses that have substantial rental and least expenses.

7. If an investor's required rate of return increases and all other characteristics of a stock remain the same, the value of the stock will _____.
   **a.** remain the same

**b.** increase
**c.** decrease
**d.** None of the above

8. A major limitation of the dividend discount model (DDM) is that _____.
   **a.** it is extremely complicated to use
   **b.** it cannot be used with companies that do not pay dividends
   **c.** it must always be used in conjunction with another metric
   **d.** None of the above

9. In which of the following ways does preferred stock differ from common stock?
   **a.** Preferred stock carries voting rights for its ownership.
   **b.** Preferred stock must be purchased through a broker dealer.
   **c.** Preferred stock may have a cumulative dividend feature.
   **d.** In the event of corporate liquidation, preferred stockholders are paid last.

10. The term efficient markets refers to the idea that _____.
    **a.** publicly traded companies always file their financial reports on time
    **b.** investors are able to identify underpriced stocks for purchase
    **c.** stocks trade with minimal costs and prices are current and fair to all traders
    **d.** financial information on companies and their stock is only available to efficient traders

## Review Questions

1. Briefly discuss one of the primary benefits of using comparative P/E ratios.
2. Name an important characteristic of companies for which the price-to-book (P/B) ratio does not work well.
3. Briefly describe the main type of scenario in which the two-stage DDM approach might be used to value a firm and its stock.
4. Briefly describe a major shortcoming of the zero growth DDM model.
5. Briefly describe the required inputs for the discounted cash flow (DCF) model.
6. Briefly describe preferred stock and some of its ownership advantages compared to common stock.
7. Briefly explain what is meant by the terms *cumulative* and *noncumulative* as they relate to preferred stocks.
8. What were SuperDOT and SOES, and what were they designed to do?
9. What are operational efficiency and informational efficiency, and how do they differ in terms of trading markets?
10. What is meant by informational efficiency, and how does it affect the price of a stock?

## Problems

1. Today, Sysco Enterprises paid dividends on its common stock of $1.25 per share. If dividends per share are expected to increase to $3.50 per share six years from now, what is the percentage dividend growth rate?
2. Let's say you want to purchase shares of Fontaine Ltd. and then hold this stock for six years. The company has a stated dividend policy of $2.00 annually per share for the next six years, at the end of which time you will sell the stock. You expect to be able to sell the stock for $35.00 at that time. If you want to earn an 8% return on this investment, what price should you pay today for this stock?
3. Damian Painting Systems has established a dividend policy of $3.00 per share per year. If the company

plans to be in business forever, what is the value of this stock if an investor wants a 10% return?

4. Wilk Productions wants its shareholders to earn a 12% return on their investment in the company. At what value would Wilk stock be priced if the company paid $2.75 per share in constant annual dividends forever?
5. Dax Industrial Systems has stock currently priced at $50.00 per share. If investors are earning a 7% return on Dax Industrial, what is the company's annual dividend payment per share?
6. If a stock is selling at $400 with a dividend in the next period of $40 and a potential investor's required rate of return is 15%, what would be the anticipated dividend growth rate?
7. Mind Max Inc. has a dividend policy that increases annual dividends by 3% each year. If last year's dividend was $2.00, the company intends to stay in business for 50 years, and an investor wants a 9% return, what would be the price of Mind Max stock?
8. Odon Corp. paid dividends today in the amount of $1.50 per share. If Odon will pay dividends of $5.00 10 years from today, what is the annual dividend growth rate over this 10-year period?
9. The Kirkson Distributors common stock is currently selling at $52.00 per share, pays dividends annually at $2.50 per share, and has an annual dividend growth rate of 2%. What is the required return?
10. If a preferred share of stock pays dividends of $2.50 per year and the required rate of return for the stock is 6%, what is its intrinsic value?

## Video Activity

### Efficient Markets

Access multimedia content (http://openstax.org/books/principles-finance/pages/11-video-activity)

1. In the efficient market hypothesis (EMH), describe what is meant by the terms *weak form efficiency, semi-strong form efficiency*, and *strong form efficiency*. How do these forms of market efficiency differ from each other, and what are their characteristics?
2. What is meant by the term *random walk*, and how does this concept relate to the EMH?

### What Is Preferred Stock?

Access multimedia content (http://openstax.org/books/principles-finance/pages/11-video-activity)

3. Discuss the relative risks of the following financial instruments and how they compare to each other: bonds, common stocks, and preferred stocks. How and why will these three investment types typically carry different levels of risk to an investor?
4. Discuss some of the important differences between preferred stocks and common stocks.

12

# Historical Performance of US Markets

**Figure 12.1** Stock markets are affected by many factors, such as interest rates, inflation, and politics. (credit: modification of "That was supposed to be going up, wasn't it? by Rafael Matsunaga/flickr, CC BY 2.0)

## Chapter Outline


**12.1** Overview of US Financial Markets
**12.2** Historical Picture of Inflation
**12.3** Historical Picture of Returns to Bonds
**12.4** Historical Picture of Returns to Stocks


## Why It Matters

Author Mark Twain spoke for many when he wrote, "October—this is one of the peculiarly dangerous months to speculate in stocks. The others are July, January, September, April, November, May, March, June, December, August, and February." Twain's comment, though humorous, reflects the serious risks associated with investing in the stock market. So why should we study the history of the US financial markets? Financial experts regularly remind us that past performance is no guarantee of future results. However, past performance can provide targets or benchmarks around which to build expectations. We can learn about the past to prepare for future possibilities, or we can suffer what Winston Churchill warned, "Those that fail to learn from history are doomed to repeat it."

Carlos Slim Helu, a Mexican businessman and the richest person in the world from 2010 to 2013, once said, "With a good perspective on history, we can have a better understanding of the past and present, and thus a clear vision of the future."[1] In this chapter, we examine current and historical performance in money, bond, and stock markets. Studying past market risk and return also allows investors to understand what is reasonable and what is not.

1 Dan Western. "45 Carlos Slim Helu Quotes About Wealth and Success." *Wealthy Gorilla*. https://wealthygorilla.com/carlos-slim-helu-quotes/

# 12.1 Overview of US Financial Markets

## Learning Outcomes

By the end of this section, you will be able to:

- Identify the various aspects of the US money markets.
- Characterize government and corporate bond markets.
- Detail the structure and operations of US equity markets.

## Money Markets

The money market is a multitrillion-dollar market. Features of money market securities include being short-term (with maturities of less than one year) and very low risk (rarely failing to make their required payments). Further, money market securities are also liquid, which means that they trade easily without losing value.

Financial institutions, corporations, and governments that have short-term borrowing and/or lending needs issue securities in the money market. Most of the transactions are quite large, with typical amounts of $10,000, $100,000, $1 million, or more. Money market securities are available in smaller amounts if you choose to invest in money market mutual funds (MMMFs) or certain types of exchange-traded funds (ETFs).

**Treasury bills (T-bills)** are short-term debt instruments issued by the federal government. T-bills are auctioned weekly by the Treasury Department through the trading window of the Federal Reserve Bank of New York, with maturities of 4, 8, 13, or 26 weeks. The Treasury also auctions 52-week T-bills once every four weeks. The federal government uses T-bills to meet short-term liquidity needs. T-bills have very short maturities and a broad secondary market and are default-risk free. T-bills are also exempt from state and local income taxes. As a result, they carry some of the lowest effective interest rates on publicly traded debt securities.

The volume of T-bills auctioned depends upon government borrowing needs. Much of the money raised at weekly T-bill auctions goes to repay the money borrowed 4, 8, 13, 26, or 52 weeks earlier. The gross amount of new T-bills issued in December 2020 was $1,591.1 billion, and the amount of T-bills retired in the same month was $1,570.6 billion, resulting in net new borrowing of "only" $20.5 billion.

In addition to the regular auction of new T-bills, there is also an active secondary market where investors can trade used or previously issued T-bills. Since 2001, the average daily trading volume for T-bills has exceeded $75 billion.

**Commercial paper (CP)** is a short-term, unsecured debt security issued by corporations and financial institutions to meet short-term financing needs such as inventory and receivables. For example, credit card companies use commercial paper to finance credit card payments. Commercial paper is a short-term debt instrument, with a typical maturity of 30 days and up to 270 days. The short maturity reduces US Securities and Exchange Commission (SEC) oversight. The lesser oversight and the unsecured nature of CP means that only highly rated firms are able to issue the uninsured paper.

Commercial paper typically carries a minimum face value of $100,000 and sells at a discount, with the face value as the repayment amount. Corporations and financial institutions, not the government, issue CP; thus, returns are taxable. Further, unlike T-bills, there is not a robust secondary market for CP. Most purchasers are large, such as mutual fund investment companies, and they tend to hold commercial paper until maturity. The default rate on commercial paper is typically low, but default rates did increase into the double-digit range during the financial crisis of 2008.

**Negotiable certificates of deposit (NCDs)** are very large CDs issued by financial institutions. They are redeemable only at maturity, but they can and often do trade prior to maturity in a broad secondary market. NCDs, or jumbo CDs, are so called because they sell in increments of $100,000 or more. However, typical amounts are $1 million, with a maturity of two weeks to six months.

NCDs differ in some important ways from the typical CD you may be familiar with from your local bank or credit union. The typical CD has a maturity date, interest rate, and face amount and has FDIC insurance. However, if an investor wishes to cash out prior to maturity, they will incur a substantial penalty from the issuer (bank or credit union). An NCD also has a maturity date and amount, but it is much larger than a regular CD and appeals to institutional investors. The principal is not insured. When the investor wishes to cash out early, there is a robust secondary market for trading the NCD. The issuing institution can offer higher rates on NCDs compared to CDs because it knows it will have use of the purchase amount for the entire maturity of the NCD and because the reserve requirements on NCDs by the Federal Reserve is lower than for other types of deposits.

Investment companies such as Vanguard and Fidelity, among many others, sell shares in money market mutual funds (MMMFs). The investment company purchases money market instruments, such as T-bills, CP, or NCDs; pools them; and then sells shares of ownership to investors (see Table 12.1). Generally, MMMFs invest only in taxable securities, such as commercial paper and negotiable certificates of deposit, or only in tax-exempt government securities, such as T-bills. Investors can then choose which type of short-term liquid securities they would like to hold, taxable or nontaxable. MMMFs provide smaller firms and investors the opportunity to participate in the money market by facilitating smaller individual investment amounts.

| Financial Instrument | Typical Maturity | Minimum Amount | Issuer |
|---|---|---|---|
| Treasury bills | 4–52 weeks | $10,000 | Federal government |
| Commercial paper | 270 days | $100,000 | Businesses |
| Negotiable CDs | 6 months | $100,000 | Financial institutions |
| MMMFs | | | Investment companies |
| Federal funds | 1 day | $1 million | Financial institutions |

**Table 12.1 Money Market Instrument Characteristics (Selected)**

The market for federal funds is notable because the Federal Reserve (Fed) targets the equilibrium interest rate on federal funds as one of its most important monetary policy tools. The federal funds market traditionally consists of the overnight borrowing and lending of immediately available funds among depository financial institutions, notably domestic commercial banks. Financial institutions such as banks are required to keep a fraction of their deposits on reserve with the Fed. When banks find they are short of reserves and immediately need cash to meet reserve requirements, they can borrow directly from the Fed through the so-called "discount window" or purchase excess reserves from other banks in the federal funds market. Often, the maturity of a federal funds contract is as short as a single day or overnight. The participants in the market negotiate the federal funds interest rate. However, the Federal Reserve effectively sets the target interest rate range in the federal funds market by controlling the supply of funds available for use in the market.

Since the financial crisis of 2008, the activities and functioning of the federal funds market has changed. The federal funds rate is still the rate targeted by the Fed for monetary policy, but the participants have evolved for several reasons. The market now includes foreign banks and non-depository financial institutions, such as the Federal Home Loan Banks. These institutions do not need to meet Fed reserve requirements and are not required to keep reserves with the Fed. In addition, the Fed now pays interest to commercial banks for reserves held at the Federal Reserve banks. Paying interest on reserves reduces the incentive for domestic commercial banks to enter the federal funds market since they can already earn interest on their excess reserves.

Daily trading volume in the federal funds market from 2016 through 2020 ranged from a high of $115 billion in March of 2018 to a low of only $34 billion on December 31, 2020.[2] The volume of federal funds activity is lower in periods of slower economic growth because banks have fewer good opportunities to issue loans and are less likely to be short of required reserves.

## Bond Markets

Bond markets are financial markets that make payments to investors for a specific period of time. Investors decide how much to pay for a bond depending on how much they expect **inflation** to affect the value of the fixed payment. There are several types of bonds: government bonds, corporate bonds, and municipal bonds.

### Government Bond Markets

In the section on money markets, we discussed T-bills, and we now discuss longer-term government securities in the form of Treasury notes and Treasury bonds.

We learned in Bonds and Bond Valuation that the federal government issues Treasury notes and bonds to raise money for current spending and to repay past borrowing. The size of the Treasury market is quite large, as the US federal government over the years has accumulated a total indebtedness of over $28 trillion dollars. The debt has grown so large we even have a real-time debt calculator online at https://www.usdebtclock.org/ (https://openstax.org/r/usdebtclock).

**Treasury notes (T-notes)** are US government debt instruments with maturities of 2, 3, 5, 7, or 10 years. The Treasury auctions notes on a regular basis, and investors may purchase new notes from TreasuryDirect.gov (https://openstax.org/r/treasurydirect.gov) in the same way they would a T-bill. T-notes differ from T-bills in that they are longer term and pay semiannual coupon interest payments, as well as the par or face value of the note at maturity. T-bills, as you will recall, sell at a discount and pay the face value at maturity with no explicit interest payments. Upon issue of a note, the size, number, and timing of note payments is fixed. However, prices do change in the secondary market as interest rates change. Like T-bills, T-notes are generally exempt from state and local taxes.

Economists and investors keep a close eye on the 10-year T-note for several reasons. Mortgage lenders use it as a basis for setting and adjusting mortgage interest rates. In general, the rate on the 10-year T-note is a reliable market indicator of investor confidence.

There is an active secondary market for Treasury notes. From 2001 to 2020, the daily trading volume for Treasury notes has averaged $395 billion, or roughly five times the daily trading volume of T-bills. Treasury notes are the largest single type of government debt instrument, with over $11 trillion outstanding. As you can see from Figure 12.2, the Treasury dramatically increased borrowing by issuing notes following the 2008 financial crisis.

Brokers, dealers, and investment companies provide secondary market opportunities for individual and institutional investors. Exchange-traded funds (ETFs) are popular investment vehicles for many types of government T-bill, T-note, and T-bond portfolios. An ETF is a basket of securities that can trade like stocks on a stock exchange. For example, IEI is an iShares ETF managed by BlackRock that invests in Treasury securities with three to seven years to maturity. When investors buy this ETF, they purchase a small bundle of Treasury notes that they can buy or sell, just as if they owned an individual share of stock. ETFs are a convenient way for investors to own broad portfolios of securities while still being able to trade the whole group in a single transaction if they choose.

2 Federal Reserve Bank of New York. "Effective Federal Funds Rate." *Federal Reserve Bank of New York.* https://www.newyorkfed.org/markets/reference-rates/effr

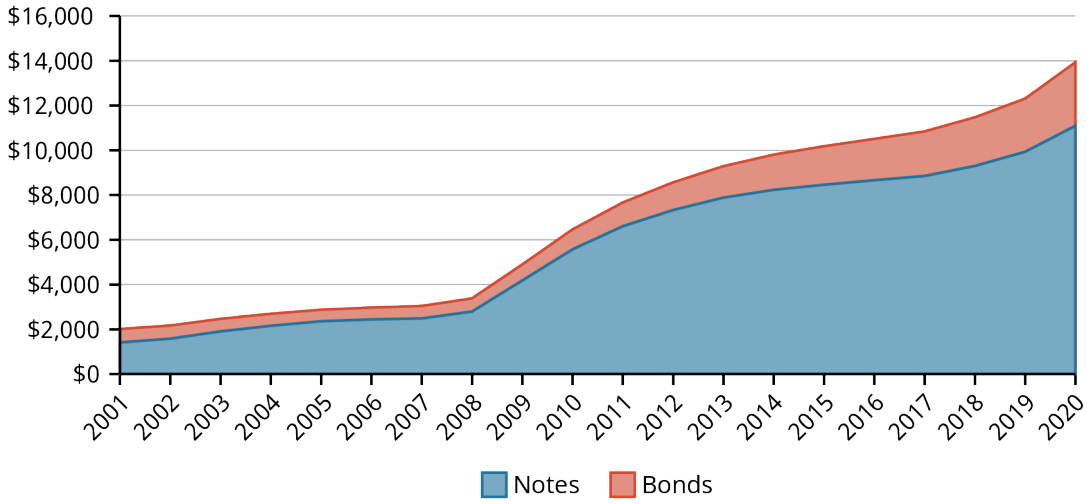



**Figure 12.2 Daily Trading Volume for US Treasury Notes and Bonds in Billions** (data source: treasurydirect.gov)

Longer-term Treasury issues, **Treasury bonds**, have maturities of 20 or 30 years. T-bonds are like T-notes in that they pay semiannual coupon interest payments for the life of the security and pay the face value at maturity. They are longer term than notes and typically have higher coupon rates. T-bonds with maturities of 20 and 30 years are each auctioned only once per month. At the end of 2020, there were approximately $2.8 trillion of T-bonds outstanding, compared to approximately $11.1 trillion and $5 trillion of T-notes and T-bills.

In 1997, the Treasury began offering a new type of longer-term debt instrument, Treasury Inflation-Protected Securities, or TIPS. TIPS currently have maturities of 5, 10, or 30 years and are auctioned by the Treasury once per month. Like T-notes and T-bonds, they offer semiannual coupon interest payments for the life of the security and pay face value at maturity. The coupon interest rates are fixed, but the principal value adjusts monthly in response to changes in the consumer price index (CPI). Inflation and deflation cause the value of the principal to increase or decrease, which results in a larger or smaller semiannual coupon payment. With a total outstanding value of approximately $1.6 trillion at the end of 2020, TIPS are the smallest form of Treasury borrowing we have discussed.[3]

State and local governments and taxing districts can issue debt in the form of **municipal bonds (*munis*)**. Local borrowing carries more risk than Treasury securities, and default or bankruptcy is atypical but possible. Thus, munis have ratings that run a spectrum similar to corporate bonds in that they receive a bond rating based on the perceived default risk. The defining feature of municipal bonds is that some interest payments are tax-free. Interest on munis (municipal bonds) is always exempt from federal taxes and sometimes exempt from state and local taxes. This makes them very attractive to investors in high income brackets.

There are two primary types of municipal bonds: revenue bonds and general obligation (GO) bonds. GO bonds generate cash flows to repay the bonds by taxing a project. For instance, a local school district may tax residents to pay for capital construction, or a city may tax citizens to pay for a new public works building. Revenue bonds, on the other hand, may apply to projects that generate sufficient cash flows to repay the bond—perhaps a utility or local toll road.

## Corporate Bond Markets

Just as governments borrow money in the long-term from investors, so do corporations. A corporation often uses bank loans, commercial paper, or supplier credit for short-term borrowing needs and issues bonds for longer-term financing. Bond contracts identify very specific terms of agreement and outline the rules for the order, timing, and amount of contractual payments, as well as processes for when one or more of the required activities lapse. **Indenture** is the legal term for a bond contract. The indenture also includes limitations on the

3 Nick Lioudis. "Where Can I Buy Government Bonds?" *Investopedia*. December 30, 2020. https://www.investopedia.com/ask/answers/where-can-i-buy-government-bonds/; TreasuryDirect. "Today's Auction Results." *TreasuryDirect*. https://www.treasurydirect.gov/instit/annceresult/press/press_auctionresults.htm

corporation for how they may use the bond proceeds.

A bond indenture includes both standard boilerplate contract language and specific conditions unique to a particular issue. Because of these non-standardized features of a bond contract, the secondary market for trading used bonds typically requires a broker, dealer, or investment company to facilitate a trade.

When a corporation uses a real asset, such as property or buildings, to guarantee a bond, the firm has issued a **mortgage bond**. However, it is more common for a corporation to issue an unsecured bond known as a **debenture**. The risk of a debenture reflects the risk of the entire corporation and does not rely on the value of a specific underlying asset, as is the case with a mortgage bond.

The risk a bondholder bears for buying a bond depends in part on the terms of the bond indenture, market conditions over the life of the bond contract, and the ability or inability of the firm to generate sufficient cash flows to meet its bond obligations. Fortunately, investors do not have to make these determinations about risk on their own. They can rely on bond rating services such as Moody's, Standard and Poor's, or Fitch to generate evaluations of the creditworthiness of bond issuers.

Ratings firms must adhere to rigorous standards when evaluating client creditworthiness. For example, Standard and Poor's begins the explanation of its evaluation process with these paragraphs:

> "S&P Global Ratings provides a Credit Rating only when, in its opinion, there is information of satisfactory quality to form a credible opinion on creditworthiness, consistent with its Quality of the Rating Process – Sufficient Information (Quality of Information) Policy, and only after applicable quantitative, qualitative, and legal analyses are performed. Throughout the ratings and surveillance process, the analytical team reviews information from both public and nonpublic sources."
>
> "For corporate, government, and financial services company or entity (collectively referred to as "C&G" Credit Ratings), the analysis generally includes historical and projected financial information, industry and/or economic data, peer comparisons, and details on planned financings. In addition, the analysis is based on qualitative factors, such as the institutional or governance framework, the financial strategy of the rated entity and, generally, the experience and credibility of management."[4]

Table 12.2 is a summary of how the three major credit rating agencies identify their ratings. Bond ratings are important for many reasons. The higher a firm's rating, the lower the expected default risk and the lower the cost of borrowing for the firm. Pension funds may be restricted to investing in only medium- or higher-grade bonds. This could limit the number of investors who can participate in the market for lower-grade bonds, thereby reducing the liquidity, price, and tradability of those debt securities.

There are only two US companies with AAA credit ratings: Microsoft and Johnson & Johnson.[5] Over the past 40 years, there has been a steady decline of AAA-rated companies (from sixty in 1980). Many institutions have found that this rating requires a more conservative approach to debt that can inhibit growth and revenue. So, in today's market, credit ratings have begun to lose their importance. It seems that the ability to pay debts has become secondary to the potential for growth.

| Fitch | Moody's | S&P | Bond Grade/Risk |
|---|---|---|---|
| AAA | Aaa | AAA | Investment/low risk |
| AA | Aa | AA | Investment/low risk |
| A | A | A | Investment/low risk |
| BBB | Baa | BBB | Investment/medium risk |

**Table 12.2 Credit Scale Ratings from the Three Credit Rating Agencies**

4 S&P Global Ratings. "Transparency Statement." *S&P Global Ratings.* https://www.spglobal.com/ratings/en/about/transparency
5 The Wall Street Insider. "Why Only Two Companies Are Left with the AAA Rating." *The Wall Street Insider.* June 12, 2020. https://www.thewallstreetinsider.com/trends/why-only-two-companies-are-left-with-the-aaa-rating

| Fitch | Moody's | S&P | Bond Grade/Risk |
|---|---|---|---|
| BB | Ba | BB | Junk/high risk |
| B | B | B | Junk/high risk |
| CCC | Caa | CCC | Junk/highest risk |

**Table 12.2 Credit Scale Ratings from the Three Credit Rating Agencies**

## Equity Markets

An important goal of firm managers is to maximize owners' wealth. For corporations, shares of stock represent ownership. A corporation could have 100 shares, one million shares, or even several billion shares of stock. Stocks are difficult to value compared to bonds. Bonds typically provide periodic interest payments and a principal payment at maturity. The bond indenture specifies the timing and the amount of payments. Stocks might have periodic dividend payments, and an investor can plan to sell the stock at some point in the future. However, no contract guarantees the size of the dividends or the time and resale price of the stock. Thus, the cash flows from stock ownership are more uncertain and risky.

Corporations are the dominant form of business enterprise in the United States because of the ability to raise capital, the ease of transfer of ownership, and the benefit of limited liability to the owners. There are generally two types of stock, preferred and common. Preferred stock is a hybrid between common stock and bonds. Preferred stock has a higher claim to cash flows than common stockholders have (thus the term *preferred*), but it is lower than that of bondholders. In addition, preferred stock has fixed cash flows as bonds have and typically has no or few voting rights. Preferred stock dividends are after-tax payments by the corporation, as are common stock dividends, but bond interest payments, paid prior to taxes, are tax-deductible for firms. Of the three, preferred stock is the least used form of capital financing for corporations.

Common stockholders are the residual claimants and owners of the corporation. After all others who have a claim against the firm are paid, the common stockholders own all that remains. Common stockholders have voting rights, typically one vote per share, and choose the board of directors.

One popular way to rank the size of companies is to determine the value of their market capitalization, or market cap. Market cap is equal to the current stock price multiplied by the number of shares outstanding. According to the World Bank, the total market cap of US firms at the end of 2020 was $50.8 trillion, making up over half of the world's total value of equity, estimated at $90 trillion.[6] The largest US company at that time was Apple, followed by Microsoft, Amazon, Alphabet (Google), and Facebook. The largest company by sales volume in 2020 was Walmart.[7]

### Geographical Location of Exchanges

Ownership is easily transferable for stocks that trade in one of the organized stock exchanges or in an over-the-counter (OTC) market. Definitions of a stock exchange and an OTC market blur as financial markets quickly adapt to innovations. However, stock markets have a centralized trading location, transactions require a broker to connect buyers and sellers, and the exchanges guarantee a basic level of liquidity so that investors are always able to buy or sell their stocks. An OTC market is an electronic market conducted on computer screens and consists of direct transactions among buyers and sellers, with no broker to bring the two together. Because there is no formal exchange present, it is possible that investors will have trouble finding buyers or sellers for their stocks.

6 Siblis Research. "Total Market Value of US Stock Market." *Siblis Research*. https://siblisresearch.com/data/us-stock-market-value/; The World Bank. "Market Capitalization of Listed Domestic Companies (current US$)." *The World Bank*. https://data.worldbank.org/indicator/CM.MKT.LCAP.CD

7 Companies Market Cap. "Largest American Companies by Market Capitalization." *Companies Market Cap*. https://companiesmarketcap.com/usa/largest-companies-in-the-usa-by-market-cap/; National Retail Federation. "Top 100 Retailers 2020 List." *National Retail Federation*. 2020. https://nrf.com/resources/top-retailers/top-100-retailers/top-100-retailers-2020-list

Most of the trading consists of used or previously issued stocks in over-the-counter markets and organized exchanges. The two largest stock exchanges in the world, as measured by the market capitalization of the companies listed on the exchange, are the New York Stock Exchange (NYSE) and the NASDAQ. Both exchanges are located in the United States. Other large stock exchanges are located in Japan, China, Hong Kong, continental Europe, London, and Saudi Arabia.

## Process of Offering Equities

The **primary market** is the market for new securities, and the **secondary market** is the market for used securities. When issuing new equity, the issuing firm receives the proceeds of the sale. Having an active secondary market makes it easier for corporations to issue stock, as investors know they can resell if desired. Most of the trading of equity securities is for used securities on the secondary market.

An **initial public offering**, or IPO, occurs when a firm offers stock to the public for the first time. With a typical IPO, a private company decides to raise capital and go public with the help of an investment banker. The investment banker agrees to provide financial advice, recommend the price and number of shares to issue, and establish a syndicate of underwriters to finance and ultimately distribute the new shares to investors (see Figure 12.3). An IPO is expensive for the issuing firm, and it can expect to incur costs of 5% to 8% or more of the value of the IPO. As of the end of 2020, the largest successful IPO belongs to Saudi Aramco, a petroleum company, valued at $25.6 billion at issue in December 2019.[8] The Ant Group had planned an IPO valued at over $34 billion dollars in 2020, but as of the end of 2020 that issue was put on hold by the Chinese government.[9]

Institutional and preferred individual investors are typically the initial purchasers of IPOs. Smaller investors rarely have the opportunity to purchase. However, any investor can buy the new shares once available for public trading. Investment author and financial expert Professor Burton Malkiel cautions that buying IPOs immediately after issue can be a money-losing investment. He cites research showing that, historically, IPOs have underperformed the market by an average of 4% per year.[10]

Another way for a corporation to raise capital in the equity market is through a **seasoned equity offering (SEO)**. An IPO occurs when a firm transitions from a private to a public company. An SEO takes place when a corporation that is already publicly traded issues additional shares of stock to the public. An SEO is often part of a SEC Rule 415 offering, or so-called **shelf registration**. Shelf registrations allow a company to register with the SEC to issue new shares but wait up to two years before issuing the shares. This gives companies the ability to register their intent to issue new shares and to "set them on the shelf" until market conditions are most favorable for issuance to the public.

8 Jennifer Rudden. "Largest IPOs Worldwide as of January 21, 2021." *Statista*. 2021. https://www.statista.com/statistics/269343/worlds-largest-ipos/

9 Deborah D'Souza. "Ant Group Set to Be World's Largest IPO Ever." *Investopedia*. October 27, 2020. https://www.investopedia.com/ant-group-set-to-be-world-s-largest-ipo-ever-5084457; Jasper Jolly. "Ant Group Forced to Suspend Biggest Share Offering in History." *The Guardian*. https://www.theguardian.com/business/2020/nov/03/biggest-share-offering-in-history-on-hold-as-ant-group-suspends-launch

10 Burton Malkiel. *A Random Walk down Wall Street*. 10th ed. W. W. Norton, 2012.

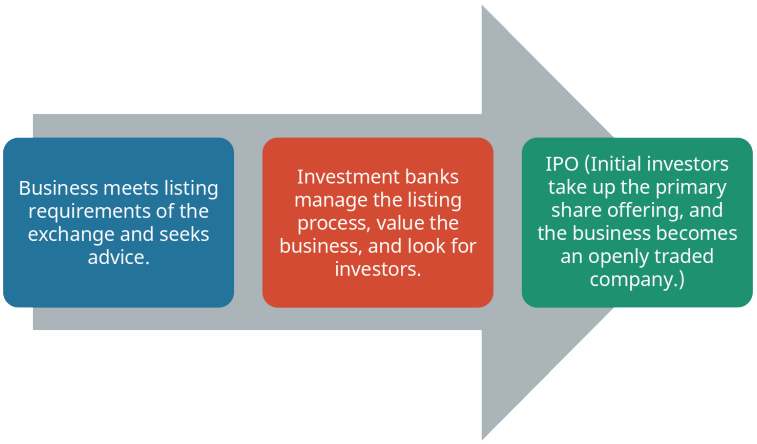



**Figure 12.3 The IPO Process**

## Alternative Methods of Raising Capital

**Special purpose acquisition companies (SPACs)** were born in the 1990s and came of age in 2019.[11] SPACs are a special form of IPO. We know that firms with products or services to sell and a documented operational and financial history often initiate an IPO to raise money by going public. A SPAC, however, is like an IPO that puts the cart before the horse. By this, we mean that rather than having a company ready to go public to raise capital, with a SPAC, a sponsor raises capital in anticipation of finding a firm ready to go public. This is why we sometimes refer to SPACs as "blank check" companies. Investors are providing capital to a firm that has no assets with the expectation that the sponsor will find a good investment.

Forming a SPAC shifts the risk and expenses associated with a firm going public. Because the money raised by the SPAC sponsor is the only asset, the process of filing with the SEC is less complicated, less expensive, and less time-consuming than filing an IPO. Often, when formed, a SPAC has a target company in mind, but this is not a requirement. Once the SPAC identifies a target firm, the sponsor can negotiate a purchase price and essentially merge with the target. Underpricing of IPOs is well documented,[12] and the owners of a private company going public do not capture the significant increase in stock price that frequently occurs in the months following an IPO.

A SPAC offering allows the private firm owners to negotiate for a better price. A July 2020 study from Renaissance Capital reports that "of 223 SPAC IPOs conducted from the start of 2015 through July 2020, 89 have completed mergers and taken a company public." According to the study, of those 89 mergers, "the common shares have delivered an average loss of 18.8% and a median return of minus 36.1%. That compares with the average after-market return from traditional IPOs of 37.2%" over the same time period.[13]

## Sequence of Trade Execution

Investors who wish to trade stocks (buy or sell) execute trades via a broker. Many online brokers today will execute your trades at low to no cost once you have established a brokerage account. When trading, it is most common to make a market order or a limit order. A market order executes a trade at the current price, while a limit order specifies the price at which the investor is willing to buy or sell. Figure 12.4 provides a visual representation of how payment for an order flow works.

11 Nicholas Jasinksi. "Blank Check Companies Are Hot on Wall Street. Investors Can't Ignore Them." *Barron's.* January 17, 2020. https://www.barrons.com/articles/boom-in-blank-check-companies-or-spacs-what-investors-need-to-know-51579299261; Julie Young. "Special Purpose Acquisition Company (SPAC)." *Investopedia.* November 24, 2020. https://www.investopedia.com/terms/s/spac.asp

12 R. G. Ibbotson, J. L. Sindelar, and J. R. Ritter. "The Market's Problems with the Pricing of Initial Public Offerings." *Journal of Applied Corporate Finance* 7 (Spring 1994).

13 Ciara Linnane. "2020 Is the Year of the SPAC—Yet Traditional IPOs Offer Better Returns, Report Finds." *MarketWatch.* September 16, 2020. https://www.marketwatch.com/story/2020-is-the-year-of-the-spac-yet-traditional-ipos-offer-better-returns-report-finds-2020-09-04; Barron's. "What Is a SPAC?" *Barron's* (video). December 11, 2020. https://www.barrons.com/video/what-is-a-spac/86E80342-FBC2-44DA-99E2-DF808CD147FF.html

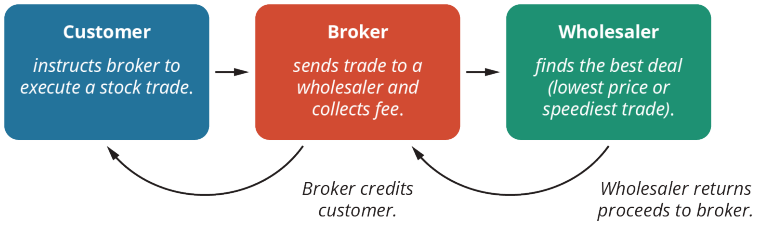



**Figure 12.4 The Order of Payments for Trade Executions**

# 12.2 Historical Picture of Inflation

## Learning Outcomes

By the end of this section, you will be able to:

- Define inflation with concrete examples.
- Describe the practical impact of inflation on consumption and salary.
- Explain how expected and actual inflation are measured.
- Detail the behavior of inflation over various historical periods.

Over time, returns in the stock market have easily outperformed returns in the bond market. However, not everyone is comfortable investing in stocks. Taking a more informed and opposing view, financial economist Jeremy Siegel queries, "You have never lost money in stocks over any 20-year period, but you have wiped out half your portfolio in bonds (after inflation). So which is the riskier asset?"[14] Siegel brings up a valid point about inflation. Returns adjusted for changes in prices provide a better measure of value or wealth. Baseball pundit Sam Ewing noted, "Inflation is when you pay fifteen dollars for the ten-dollar haircut you used to get for five dollars when you had hair."[15] If what you have earned on your investments fails to keep up with changing prices, you may have a larger portfolio with less purchasing power.

## Expected versus Actual Inflation

Inflation occurs when things cost more and your money buys less today than it did yesterday. It is understandable to dislike inflation and to be concerned over the prospect of rising prices. In fact, two of the primary policy objectives of the Federal Reserve are to work for price stability and moderate interest rates. However, is inflation necessarily good or bad? In practice, inflation can benefit some people and harm others at the same time. Consider the impact of differences in expected and actual realized inflation. Empirical evidence suggests that, on average, economists do a good job of developing inflation rate forecasts that match the actual rate of inflation. Estimated inflation is built into the interest rates investors require or are willing to pay for financial products, such as fixed-rate loans or bonds. When the actual rate of inflation exceeds the estimated rate on a product, such as a mortgage loan, this means borrowers are repaying the loan with less-valuable dollars and benefit from the increased inflation rate. Lenders, however, receive those inflation-impacted dollars and are harmed due to their unexpected decrease in purchasing power.

Deflation, or falling prices, is associated with economic recessions or even depressions and is thought to be an even more serious problem than inflation. Generally, policy makers tend to support moderate inflation, being careful to stay away from zero or negative price changes.

## Inflation Impacts

Ultimately, inflation redistributes wealth. Lenders providing fixed-rate loans receive less-valuable dollars in return. Borrowers repay with those same less-valuable dollars. Workers receive less-valuable dollars, especially when their wage increases lag behind changes in prices. Modest inflation can benefit a consumer-driven economy like the United States if consumers are motivated to spend money before prices increase. However,

14 Jeremy J. Siegel. *Stocks for the Long Run: The Definitive Guide to Financial Market Returns & Long-Term Investment Strategies.* McGraw-Hill, 2002. First published 1994.
15 Sam Ewing. "Sam Ewing Quotes." *Brainy Quotes.* https://www.brainyquote.com/authors/sam-ewing-quotes

too much inflation can cause frenzied buying, drive prices even higher, and outpace the rate of wage increases. Higher inflation raises the rates on new borrowing instruments and can slow the rate of business investment and economic growth. Inflation raises overall prices and may cause hardship for consumers on a fixed income.

Finally, inflation does not have an equal impact on all goods and services. As Table 12.3 shows, consumer prices did not increase at the same rate for the selected items shown. From 1980 to 2020, inflation, as measured by the consumer price index (CPI), grew at an average annual rate of 2.90%. However, the price of college tuition and fees increased at more than double that rate. Rent, another large expense for most college students, increased at an annual rate of 3.67%, also well above the average increase in the CPI. The price increases for ground beef and butter were slightly less than the CPI average. For the selected items presented here, only the average price for used cars and trucks rose at a rate significantly lower than the average rate of inflation.

| Year | 1980 | 2000 | 2020 | Annual Change |
|---|---|---|---|---|
| College tuition and fees | 70.8 | 331.9 | 877.3 | 6.49% |
| Rent | 80.9 | 183.9 | 341.5 | 3.67% |
| Used cars and trucks | 62.3 | 155.8 | 144.2 | 2.12% |
| Ground beef | 104.6 | 125.2 | 296.2 | 2.64% |
| Butter | 89.4 | 135.9 | 248.7 | 2.59% |
| **CPI (1982 to 1984 = 100)** | **82.4** | **172.2** | **258.8** | **2.90%** |

**Table 12.3 Changing Consumer Price Levels—Selected Goods** (source: US Bureau of Labor Statistics, Consumer Price Index)

## Using Graphs and Charts to Plot Inflation Behavior

The CPI is a measure of how prices have changed for a basket of goods across the United States. Figure 12.5 shows the eight major categories of expenditures included in the CPI.[16] Different regions of the country and population subgroups may experience different rates of inflation. Retired people may spend a greater portion of their income on healthcare than someone in their twenties.[17] Residents on the East and West Coasts spend a higher percentage of their earnings on housing than those living in the Midwest.[18] As such, there are several different measures of inflation based on geographic region or other factors.[19] It is worth noting that a basket of goods and services that cost $100 in 1984 would cost approximately $260 by the end of 2020, an increase of 160% (see Figure 12.6)! Over that same period, the average annual rate of inflation as measured by the CPI was 2.55%. These numbers make it easy to see that even a relatively modest annual inflation rate, lower than the long-run annual US inflation rate of 3%, results in significant price increases.

16 US Bureau of Labor Statistics. "Consumer Price Index." *US Bureau of Labor Statistics.* https://www.bls.gov/cpi/
17 Chris Farrell. "The Truth About Health Care Costs in Retirement." *Forbes.* June 28, 2018. https://www.forbes.com/sites/nextavenue/2018/06/28/the-truth-about-health-care-costs-in-retirement/
18 US Department of Housing and Urban Development, Office of Policy Development and Research. "Rental Burdens: Rethinking Affordability Measures." PD&R Edge. September 22, 2014. https://www.huduser.gov/portal/pdredge/pdr_edge_featd_article_092214.html
19 Khan Academy. "How Changes in the Cost of Living Are Measured." *Khan Academy.* https://www.khanacademy.org/economics-finance-domain/macroeconomics/macro-economic-indicators-and-the-business-cycle/macro-price-indices-and-inflation/a/how-changes-in-the-cost-of-living-are-measured-cnx

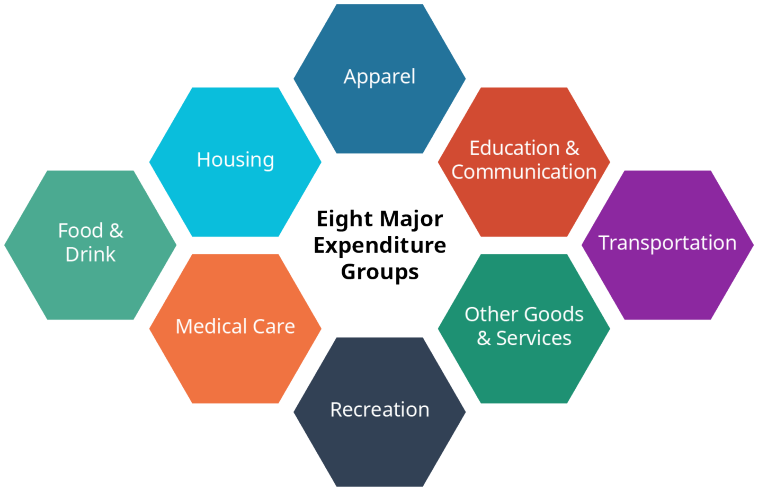



**Figure 12.5 The Market Basket Categories of the CPI**

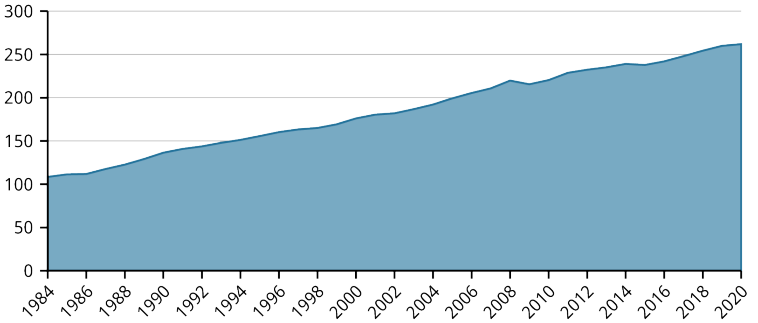



**Figure 12.6 United States Consumer Price Index (CPI) 1984–2020** (data source: US Bureau of Labor Statistics)

## CONCEPTS IN PRACTICE

### Profile of Janet Yellen

**Figure 12.7 Janet Yellen** (credit: "Janet Yellen Official Federal Reserve Portrait." United States Federal Reserve/Wikimedia Commons, Public Domain)

Janet Yellen has led a life of firsts. After graduating as valedictorian of her high school class, Yellen later attended Yale University and was the only woman in her 1971 PhD graduating class in economics. Men have long dominated the "dismal science" of economics, but Yellen has proved to be an exception.

Motivated by an undergraduate economics professor at Pembroke College of Brown University, Yellen realized how much the US central bank, known as the Federal Reserve, could influence the lives of ordinary people. She changed her major to economics, and the rest, as they say, is history.

In her first stint working with the Federal Reserve in 1977, Yellen met and married George Ackerlof. Ackerlof would go on to win a Nobel Prize in Economics. Ackerlof and Yellen eventually established themselves as faculty members at the University of California, Berkeley. Yellen was twice named Outstanding Teacher in the Haas School of Business and was recognized for her award-winning research.

In 1993, Yellen began her second tour at the Federal Reserve as an appointed member of the Board of Governors. She left this position in 1997 to head President Bill Clinton's Council of Economic Advisers. Yellen became just the second woman to head the presidential council.

She then returned to California and the Bay Area, eventually becoming president of the Federal Reserve Bank of San Francisco from 2004 to 2010. Later that year she became the vice chair of the Federal Reserve. Four years later, in 2014, Yellen assumed leadership as the first woman chair of the Federal Reserve System.

As Fed chair, Yellen earned an enviable record. During her four-year tenure, the rate of unemployment decreased by more than 2.5%, and employment increased in every month of her term. This is the first and only time in the history of the Federal Reserve that the board chair has overseen continuous increases in

employment over their entire tenure.

Now, another first: In 2021, President Joe Biden appointed Yellen as the first woman Secretary of the Treasury. Yellen has a storied career and a long list of accomplishments, but surely her record of firsts will prove to be an important and lasting legacy for women in business, government, and economics everywhere.

(Sources: Ann Saphir. "Factbox: Janet Yellen's Road to US Treasury Secretary." Reuters. November 24, 2020. https://www.reuters.com/article/idUSKBN2832WS; Ylan Q. Mui. "New Fed Chief Janet Yellen Lets a Long Career of Breaking Barriers Speak for Itself." *Washington Post.* February 2, 2014. https://www.washingtonpost.com/business/economy/new-fed-chief-janet-yellen-has-long-history-of-breaking-barriers/2014/02/02/9e8965ca-876d-11e3-833c-33098f9e5267_story.html; Stephanie Grace. "Banker to the Nation." *Brown Alumni Magazine*. October 30, 2013. https://www.brownalumnimagazine.com/articles/2013-10-30/banker-to-the-nation)

# 12.3 Historical Picture of Returns to Bonds

## Learning Outcomes

By the end of this section, you will be able to:

- Detail the behavior of sovereign (government) bonds over various historical periods.
- Detail the behavior of corporate bonds over various historical periods.
- Extract sovereign and corporate bond investment results from plots and charts.

## Federal Government Bond Behavior, Discussion, Charts, and Graphs

United States Treasury (sovereign) bonds are among the safest investments available. In fact, T-bonds often serve as the proxy for a risk-free investment in financial modeling. However, even though T-bonds may be essentially default-risk free, they do change value as interest rates change. Look at Figure 12.8, showing annual T-bond returns from 1980 to 1999. None of these bonds defaulted, yet investors realized very different returns on their investments from year to year. The **total returns** reflect interest payments plus the change in price because of changes in interest rates.

The late 1970s experienced high rates of inflation and interest rates. As those rates began to fall in late 1981, bond prices rose. Investors holding T-bond portfolios realized very large returns on their risk-free investments in 1982. That year provided the highest annual return in the 20-year period, with an annual return of 32.81%. The lowest annual return was in 1999, as the Federal Reserve began to raise rates to temper an overheating stock market caused by dot-com speculation gaining momentum. When the Fed raised interest rates, the prices on existing bonds fell, and investors realized a -8.25% return on their bond portfolios. Thus, the range in returns on these "low risk" investment securities was over 41% from the highest to the lowest annual return in this particular two-decade span. Overall, the average annual return on T-bonds from 1980 to 1999 was a robust 10.21%, boosted in part by the above average annual inflation rate of 4.28%.

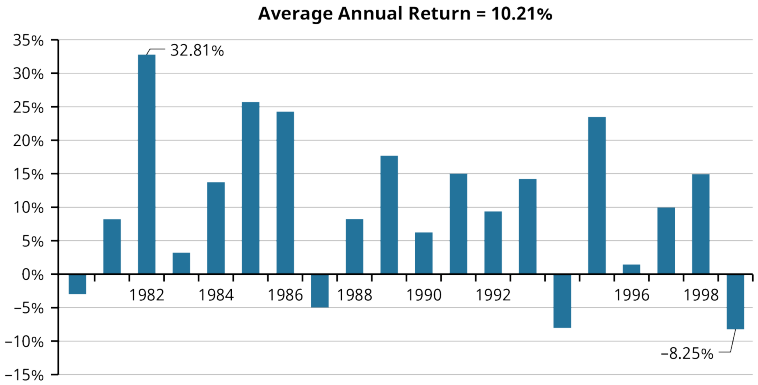



**Figure 12.8 Treasury Bond Performance, 1980–1999** (data source: Aswath Damodaran Online)

Inflation slowed from 2000 to 2020, and the average annual rate of return on T-bonds fell accordingly (see Figure 12.9). With reduced variability of interest rates in the new century and interest rates in general being lower, the returns on bond portfolios were also lower on average. T-bonds in the first two decades of the twenty-first century averaged an annual return of 5.77%, very close to the long-run average return in the previous century. The range of returns was also smaller than the previous two decades, with the highest annual return topping out at 20.10% in 2008 and the lower end dipping down to -11.12% in 2009 as the Fed made a significant effort to reduce interest rates in an attempt to stimulate the economy following the Great Recession.

## Corporate Bond Behavior, Discussion, Charts, and Graphs

The performance of Baa bonds is very similar to T-Bonds over the four decades spanning 1980 to 2020 (see Figure 12.10). These bonds are not default-risk free and require a risk premium for investors. The average annual return of 12.07% from 1980 to 1999 topped T-bonds by 1.86%. The margin was greater in the period from 2000 to 2020 (see Figure 12.11), with Baa bonds (mid-tier corporate bonds) realizing an average annual premium of 2.30% over the default-risk free T-bonds.

These premiums translate to a substantial increase in investment performance. For example, had an investor placed $100 into a T-bond portfolio in 1980, the value of the investment would have been $1,931 by year-end 2020. This would have easily outpaced the rate of inflation but significantly lagged the ending value of $4,506 on a similar Baa bond portfolio investment (see Figure 12.12).

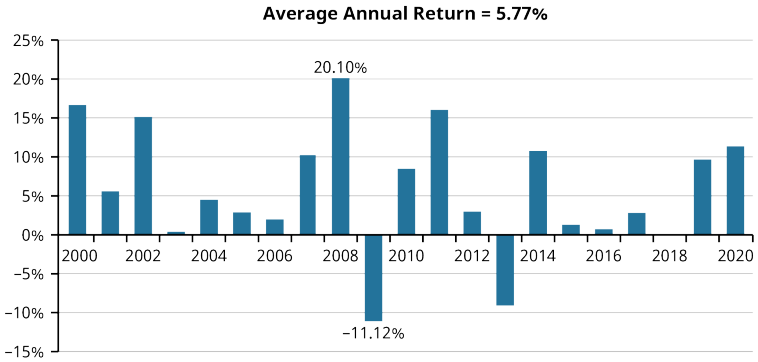



**Figure 12.9 Treasury Bond Performance, 2000–2020** (data source: Aswath Damodaran Online)

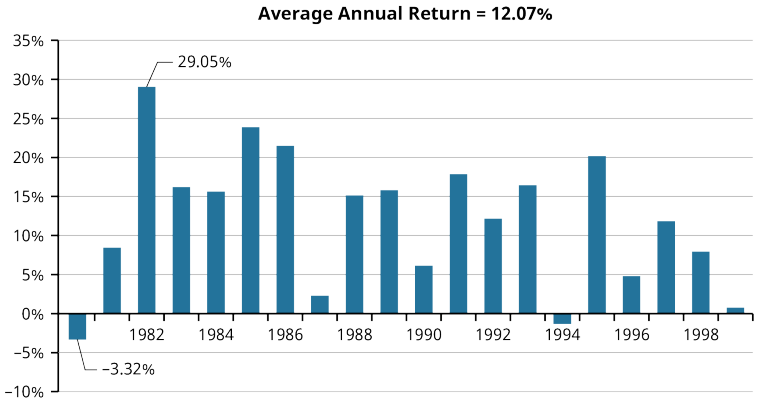



**Figure 12.10 Baa Bond Performance, 1980–1999** (data source: Aswath Damodaran Online)

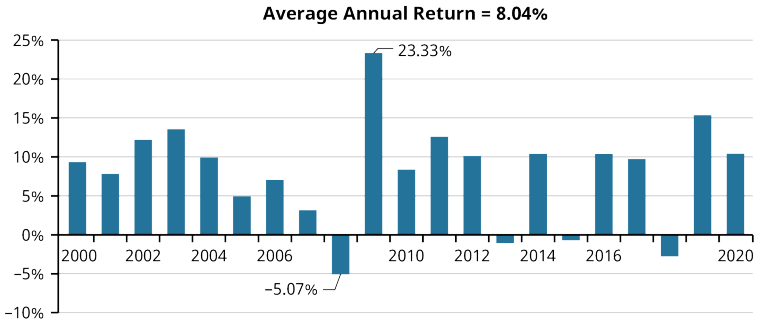



**Figure 12.11 Baa Bond Performance, 2000–2020** (data source: Aswath Damodaran Online)

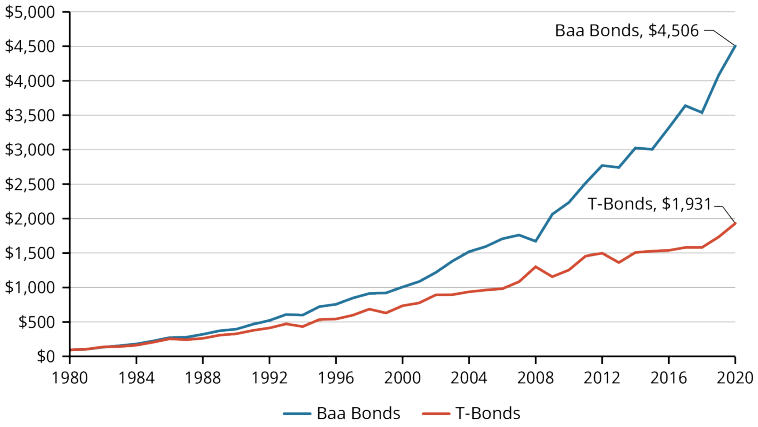



**Figure 12.12 Baa Bonds versus T-Bonds Performance, 1980–2020** (data source: Aswath Damodaran Online)

## CONCEPTS IN PRACTICE

### Profile of Bill Gross

Bill Gross may be the most successful fixed-income investor ever, but he is also a prime example of the application of the efficient market theory. In over 40 years of investing in bonds and other types of fixed-income securities worldwide, Bill Gross earned his moniker “the bond king.”

In 1971, Gross cofounded and began his long tenure as managing director and chief investment officer of Pacific Investment Management Company, better known as Pimco. Gross was not yet 30 years old, but he had already graduated from college, served in the Navy in Vietnam, and even briefly worked as a professional blackjack player in Las Vegas to bankroll the cost of his MBA from UCLA.

Gross helped change the definition of success for bond investors by focusing on total returns, including

price changes, rather than simply bond yields. He used mathematical modeling and invested worldwide and in different types of bond markets seeking risk-adjusted returns. Gross made active rather than passive management of bond funds a successful investment strategy. In the process, he changed how mangers oversee fixed-income portfolios today.

Pimco grew into an investment powerhouse under Gross's direction, eventually managing over $1.5 trillion dollars in assets. During the financial crisis of 2008, Gross served as an adviser to the US Treasury. Morningstar named him "fixed income fund manager of the decade" in 2010. In addition, Gross profited from his investment prowess, amassing a fortune in excess of $2 billion.

Gross's investment strategy was to carefully analyze the known factors about debt instruments and pair that analysis with the unknown future. He was uncanny in his ability to estimate future prices, interest rates, and macroeconomic conditions to make profitable investments.

However, as efficient markets would posit, the odds began to catch up with Gross in the latter part of his investing career. After leaving Pimco in 2014, Gross was unable to match his earlier performance successes and failed to beat bond fund performance averages. Much of Gross's investment strategy allowed him to look for **bond returns** by investing in any type of bond, with any maturity, in any country, and in any location. For decades, he was right more often than wrong in his investment choices. However, statistically, his approach to investing suggested that, unless he could see the future, at some point his expectations would be incorrect. Perhaps Gross's greatest competition comes from a generation of investment managers who learned and improved upon his proven strategies. He retired as an active public fund manager in 2019.

Today, Gross continues to manage his personal fortune, as well as the assets in his family charitable foundation. Gross and the foundation have donated over $800 million to several causes over the last two decades. In 2020, Gross joined Bill Gates, Warren Buffett, and hundreds of other billionaires in signing the Giving Pledge, whose signees promise to donate over 50% of their wealth during their lifetime and/or upon their death.

(Sources: Mary Childs. "Bill Gross Made the Bond Market What It Is Today." *Barron's.* February 8, 2019. https://www.barrons.com/articles/bill-gross-bond-market-investing-legacy-51549669974; Jeff Sommer. "Once the 'Bond King,' Bill Gross Is Retiring, His Star Dimmed." *New York Times.* February 4, 2019. https://www.nytimes.com/2019/02/04/business/bond-king-bill-gross-retirement.html; CNN. "Bill Gross Fast Facts." *CNN.* March 31, 2021. https://www.cnn.com/2013/04/08/us/bill-gross-fast-facts/)

# 12.4 Historical Picture of Returns to Stocks

## Learning Outcomes

By the end of this section, you will be able to:

- Explain overall equity market behavior over various historical periods.
- Explain different equity style and size behavior over various historical periods.
- Extract various equity market performance results from plots and charts.

## Using Graphs and Charts to Plot Equity Market Behavior Stock Size Considerations

The Dow Jones Industrial Average (DJIA), also known as the Dow 30) and the S&P 500 Index are the most frequently quoted stock market indices among scholars, businesses, and the public in general. Both indices track the change in value of a group of large capitalization stocks. The changes in the two indices are highly correlated.

It may be fair to question if either index is a good representation of the value of equity and the changes in value in the market because there are over 6,000 publicly traded companies listed on organized exchanges and thousands of additional companies that trade only over the counter. As of year-end 2020, the S&P 500 firms had a combined market capitalization of $33.4 trillion, about 66% of the estimated US equity market capitalization of $50.8 trillion.[20] It is widely agreed that the performance of the S&P 500 is a good representation of the broader market and more specifically of large capitalization firms.

Figure 12.13 provides a visualization of how S&P 500 **stock returns** have stacked up since 1900. This figure makes it clear that equity returns roughly follow a bell curve, or normal distribution. Thus, we are able to measure risk with standard deviation. A lower standard deviation of returns suggests less uncertainty of returns and therefore less risk.

Capital market history demonstrates that the average return to stocks has significantly outperformed other financial security classes, such as government bonds, corporate bonds, or the money market. Table 12.4 provides the return and standard deviation of several US investment classes over the 40-year period 1981–2020. As you can see, stocks outperformed bonds, bills, and inflation. This has led many investment advisers to emphasize asset allocation first and individual security selection second. The intuition is that the decision to invest in stocks rather than bonds has a greater long-run payoff than the change in performance resulting from the selection of any individual or group of stocks.

Figure 12.14 demonstrates the growth of a $100 investment at the start of 1928. Note that the value of the large company portfolio is more than 50 times greater than the equal investment in long-term US government bonds. This supports the importance of thoughtful asset allocation.

Still, the size of a firm has a significant impact on how investors choose equity securities. Capital market history also shows that a portfolio of small company stocks has realized larger average annual returns, as well as greater variability, than a portfolio of large companies as represented by the S&P 500. Small-cap stock total returns ranged from a high of 142.9% in 1933 to a low of -58.0% in 1937.

More recently, the differential return between small and large capital stocks has not been as pronounced. From 1980 through 2020, the Wilshire US Small-Cap Index has averaged an annual compound return of 12.13% compared to the Wilshire US Large Cap Index average of 11.82% over the same period. The 31-basis point premium is much smaller than that realized in the 1926–2019 period, which saw a small-cap average annual compounded return of 11.90% versus 10.14% for the large-cap portfolio.

20 Spencer Israel. "The Number of Companies Publicly Traded in the US Is Shrinking—Or Is It?" *MarketWatch.* October 30, 2020. https://www.marketwatch.com/story/the-number-of-companies-publicly-traded-in-the-us-is-shrinkingor-is-it-2020-10-30; Siblis Research. "Total Market Value of US Stock Market." *Siblis Research.* https://siblisresearch.com/data/us-stock-market-value/

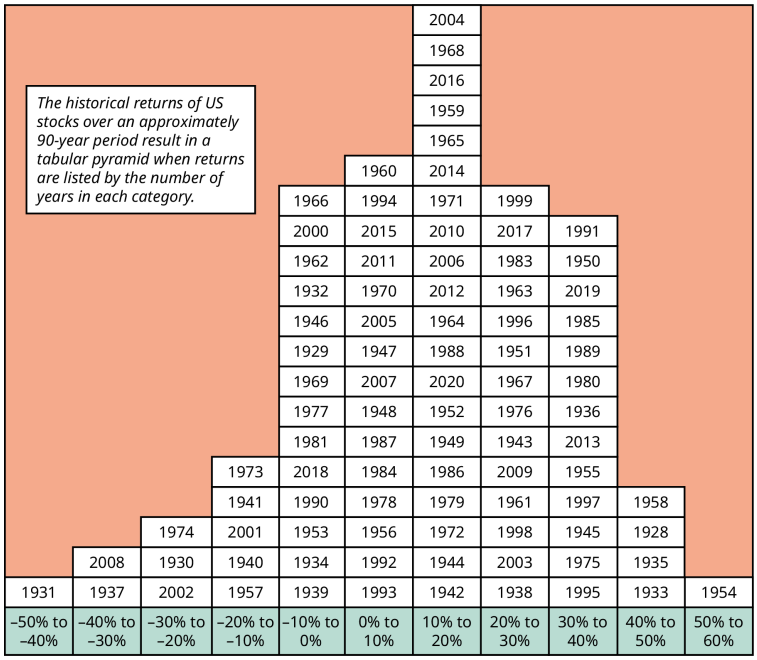



**Figure 12.13 The Pyramid of Equity Returns: Distribution of Annual Returns for the S&P 500 Index, 1928–2020** (data source: Aswath Damodaran Online)

| Asset Class | Nominal Average Annual Returns 1981–2020 | Standard Deviation of Returns 1981–2020 |
|---|---|---|
| Large company stocks | 12.64% | 16.06% |
| Baa bonds | 10.34% | 7.67% |
| 10-year T-bonds | 8.21% | 9.92% |
| US T-bills | 3.94% | 3.39% |
| Inflation | 2.93% | 1.76% |

**Table 12.4 Arithmetic Average Annual Returns and Standard Deviation by Asset Class, 1981–2020 (source: Aswatch Damodaran Online)**

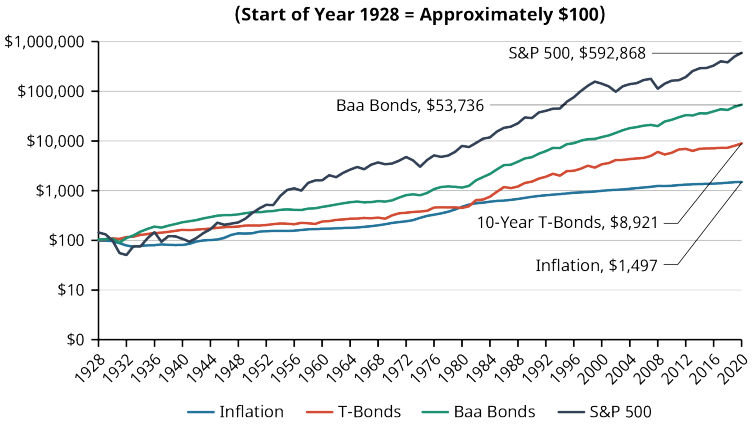



**Figure 12.14 Growth of a $100 Investment into Selected Asset Portfolios, 1928–2020** (data source: Aswath Damodaran Online)

## LINK TO LEARNING

### Would You Like to Research More Historical Returns?

This article on historical returns and risks (https://openstax.org/r/6-what-to-invest-in) contains calculators that can help you find returns over your selected periods for US stocks, bonds, and inflation. How have the markets done since you were born? This second article about global equity markets (https://openstax.org/r/returns-of-global-stocks) has a comparable calculator. You can also go to the *Global Wealth Report (https://openstax.org/r/global-wealth-report)*, an annual publication by Credit Suisse, to dig more deeply.

## LINK TO LEARNING

### Does It Pay to Time the Market?

Over the period 1980 to mid-2020, an investment of $10,000 into an S&P 500 index fund would have yielded the investor $697,421. However, missing the 5 best-performing days in the market would have reduced the final portfolio balance to $432,411. Stay out of the market on the 10 best days, and the balance would have ended at only $313,377, or less than half of the return earned in the full time period. Watch this *Wall Street Journal (https://openstax.org/r/wall-street-journal-video)* video on the DJIA to learn more.

## CONCEPTS IN PRACTICE

### Warren Buffett

**Figure 12.15 Warren Buffett** (credit: "Warren Buffet at the 2015 Select USA Investment Summit." USA International Trade Administration/Wikimedia Commons, CC Public Domain Mark)

Warren Buffett has not always been one of the richest people in the world, but he has always been one of the hardest workers. An entrepreneur from an early age, Buffett's yearbook photo caption noted that he "likes math: a future stockbroker." Before leaving high school, Buffett had already earned thousands of

dollars running a paper route and through one of his start-up businesses of installing and maintaining pinball machines in barbershops.

As they say in Nebraska, "you need to make hay while the sun shines," and Buffett has made his share of hay, so to speak. In his career, Buffett has accumulated enough hay to be one of the wealthiest people in the world, with a net worth of over $80 billion by the end of 2020.

The "Oracle of Omaha," as Buffett is known, grew his fortune through investing partnerships and most notably as the chairman, president, CEO, and largest stockholder of Berkshire Hathaway (BRK). Berkshire Hathaway was a New England textile manufacturer when Buffett and his investment partners began buying shares in the 1960s. By 1966, after a dispute with the then CEO of Berkshire, Buffett assumed control of the company and fired the CEO. Soon, Buffett's partnerships merged into Berkshire and moved the business away from textiles; it eventually became the largest financial services company in the world, including total ownership of the Geico Insurance Company.

Buffett's career is notable for how he developed his fortune, how he explained his philosophy, and for his current and future plans. Buffett followed the method of Benjamin Graham, famous value investor and author of *Security Analysis*, *The Intelligent Investor*. However, Buffett expanded beyond Graham's analysis of financial statements and intrinsic value to examine the character of executive management. He applied the same criteria to hiring employees as well. Buffett once noted, "We look for three things when we hire people. We look for intelligence, we look for initiative or energy, and we look for integrity. And if they don't have the latter, the first two will kill you, because if you're going to get someone without integrity, you want them lazy and dumb." When speaking of integrity, Buffett went on to say, "Only when the tide goes out do you discover who's been swimming naked."

Buffett's folksy way of making his point will undoubtedly be another of his legacies. When asked repeatedly about how he managed to be such a successful investor, Buffett replied, "Never invest in a business you can't understand." Never was this truer than in the late 1990s and 2000, when the dot-com craze fueled the stock market with technology firms enjoying tremendous price increases without the corresponding earnings. Buffett's value investing lagged until the bubble burst, and suddenly he was back on top. When asked about his change in fortune he replied, "In the business world, the rearview mirror is always clearer than the windshield."

Buffett believes in long-term rather than short-term investing. He once remarked that "Someone's sitting in the shade today because someone planted a tree a long time ago" and "If you aren't willing to own a stock for 10 years, don't even think about owning it for 10 minutes."

The third aspect of Buffett's legacy will be how his money works now and after he is gone. With Bill and Melinda Gates, Buffett started the Giving Pledge, and to date they have gathered the pledge of over 200 billionaires to give away half or more of their fortune during and after their lifetimes. Buffett states, "If you're in the luckiest 1% of humanity, you owe it to the rest of humanity to think about the other 99%." Buffett has begun the process to give away most of his fortune, but he has left this pearl of wisdom for his own children: "A very rich person should leave his kids enough to do anything, but not enough to do nothing."

(Sources: Joshua Kennon. "How Warren Buffett Became One of the Wealthiest People in America." *The Balance.* May 4, 2021. https://www.thebalance.com/warren-Buffett-timeline-356439; Ty Haqqi. "Five Largest Financial Services Companies in the World." *Insider Monkey.* November 26, 2020. https://www.insidermonkey.com/blog/5-largest-financial-services-companies-in-the-world-891348/2/; Mohit Oberoi. "Warren Buffett: Growth Stocks Look Like Dot-Com Bubble." *Market Realist.* September 4, 2020. https://marketrealist.com/2020/07/warren-buffett-growth-stocks-like-dot-com-bubble/)

## LINK TO LEARNING

### Does It Pay to Invest Globally?

On a global basis, US equity markets have been among the highest performing since 1900. Only Australia shows a higher average annual return over the 121-year period. Many factors contribute to long-run stock performance in any given country. However, over the period studied, the United States benefited from an entrepreneurial spirit and distance from the center of two world wars. An article reviewing global stock market returns from 1900 to 2020 summarizes and analyzes global market return information created by researchers Elroy Dimson, Paul Marsh, and Mike Staunton for Credit Suisse.[21]

While most established economies have not generated higher returns than the US equity markets, they do offer the benefits of diversification. Further, the greatest return potential—and the greatest risk of loss—may lie in developing economies. Investing experts are not in complete agreement about the advantages and disadvantages of investing in foreign equity markets. This article provides a framework for analysis and tools (https://openstax.org/r/returns-of-global-stocks) for comparing equity returns by country from 1970 through 2020. Has Australia continued to be the top-performing equity market since 1970? Have equity markets performed as well or better in the last 21 years compared to the 121-year period? Does the article encourage you to diversify internationally or focus only on domestic securities?

21 Karl Steiner. "Historical Returns of Global Stocks." *Mindfully Investing*. July 6, 2020. https://www.mindfullyinvesting.com/historical-returns-of-global-stocks/; Elroy Dimson, Paul Marsh, and Mike Staunton. *Summary Edition Credit Suisse Global Investment Returns Yearbook 2020*. Credit Suisse, February 2020. https://www.credit-suisse.com/media/assets/corporate/docs/about-us/research/publications/credit-suisse-global-investment-returns-yearbook-2020-summary-edition.pdf

# Summary

## 12.1 Overview of US Financial Markets

One way to parse financial markets is by the maturity of financial instruments. With this dichotomy, we explored the money market and the capital market. The money market consists of short-term securities and the capital market of longer-term securities. The capital market discussion focused on debt and equity as financial instruments used to finance longer-term capital financing needs. IPOs or SPACs are vehicles for raising new equity. Most trading on organized exchanges or over-the-counter markets is for used, or secondary, securities.

## 12.2 Historical Picture of Inflation

The Federal Reserve considers moderate inflation rates optimal in their oversight of the US economy. We measure inflation by comparing the price of a bundle or basket of goods over time and documenting how prices change. Since not everyone consumes similar baskets of goods, we calculate several different measures of inflation. The most commonly quoted measure of inflation uses changes in the Consumer Price Index (CPI).

## 12.3 Historical Picture of Returns to Bonds

Historical bond yields are published going back hundreds of years but are only reliably available for the last 100 years or so. In large part, the returns realized on portfolios of bonds have been smaller and less variable than the returns realized for equities.

## 12.4 Historical Picture of Returns to Stocks

Stocks have produced the greatest average annual rates of return of the money and capital market assets discussed in this chapter. Stockholders bear more risk than bondholders or money market investors and receive on average higher average annual returns. Despite the relatively high average annual rate of return for portfolios of stock, history shows that the equity markets earn negative annual returns about 25% of the time. The negative returns realized by equities occur far more often than the negative results realized by money market or debt market instruments.

# Key Terms

**bond returns** sums the periodic interest payments and the change in bond price in a given period and divides by the bond price at the beginning of the period

**commercial paper (CP)** a short-term, unsecured security issued by corporations and financial institutions to meet short-term financing needs such as inventory and receivables

**debenture** a common type of unsecured bond issued by a corporation

**indenture** legal term for a bond contract

**inflation** a general increase in prices and a reduction in purchasing power; expected rate is a key component of interest rates

**initial public offering (IPO)** the first time a firm offers stock to the public

**mortgage bond** bond issued by a corporation using a real asset, such as property or buildings, to guarantee it

**municipal bonds (munis)** bonds issued by a local government, territory, or agency; generally used to finance infrastructure projects

**negotiable certificates of deposit (NCDs)** large CDs issued by financial institutions; redeemable at maturity but can trade prior to maturity in a broad secondary market

**primary market** market for new securities

**seasoned equity offering (SEO)** a method used by new IPOs to raise capital by offering additional shares of stock to the public

**secondary market** market for used securities

**shelf registration** part of Securities and Exchange Commission (SEC) Rule 415; allows a company to register with the SEC to issue new shares but allows up to two years before issuing the shares

**special purpose acquisition companies (SPACs)** a special form of IPO

**stock returns** sums the periodic dividend payments plus the change in stock price in a given period divided by the stock price at the beginning of the period

**total returns** the sum of all cash flows received from an investment; includes periodic cash flows plus price appreciation or price depreciation

**Treasury bills (T-bills)** short-term debt instruments issued by the federal government and maturing in a year or less

**Treasury bonds** government debt instruments with maturities of 20 or 30 years

**Treasury notes (T-notes)** government debt instruments with maturities of 2, 3, 5, 7, or 10 years

## Multiple Choice

1. Which of the following statements about Treasury bills is false?
   a. T-bills sell at a discount from face value and pay the face value at maturity.
   b. T-bills have maturities of 2, 3, 5, 7, or 10 years.
   c. T-bill auctions take place weekly.
   d. T-bill denominations are relatively small compared to other money market instruments, with initial auction sizes of as little as $10,000 per T-bill.

2. If an investor wishes to simply execute a stock trade at the current market price, they should issue a _____.
   a. limit order
   b. stop loss order
   c. market order
   d. hedge order

3. Based on nominal average annual returns over the period 1980–2020, list the order of returns by asset class from highest to lowest.
   a. large company stocks, Baa bonds, small company stocks, T-bills
   b. small company stocks, large company stocks, Baa bonds, T-bills
   c. T-bills, Baa bonds, small company stocks, large company stocks
   d. small company stocks, large company stocks, T-bills, Baa bonds

4. A $1 investment in a portfolio of small company stocks in 1928 would have grown to over _____ by mid-2019.
   a. $35,000
   b. $8,000
   c. $800
   d. $80

5. Since 1980, the compound average annual growth rate for large company stocks has been _____.
   a. greater than Baa bonds but less than small company stocks
   b. greater than small company stocks but less than Baa bonds
   c. greater than Baa bonds and small company stocks
   d. less than Baa bonds and small company stocks

## Review Questions

1. Define the competitive and noncompetitive bid process for US Treasury bills.

2. How does a negotiable certificate of deposit (NCD) differ from the typical certificate of deposit you may see advertised by your local bank?

3. If you are an investor concerned about unexpected inflation in the coming years which of the following investments offers the greatest protection against inflation, and why: T-notes, T-bonds, or TIPS?
4. Debentures are more common than mortgage bonds issued by corporations. Why do you think debentures are more popular with investors? Be sure to define each bond contract in your discussion.
5. Market capitalization is a common way to rank firm size. Search the internet to identify and define at least two other ways to rank firms based on size. Identify at least one reason you prefer market capitalization as the method of choice to rank firm size.
6. Compare and contrast an SEO, IPO, and SPAC. If Ford Motor Company wished to raise new equity capital, which of these vehicles would they use?
7. Compared to a "best efforts" form of underwriting, how does "firm commitment" underwriting transfer risk from the issuing firm to the underwriter?
8. How would a decrease in inflation affect the interest rate on an adjustable-rate debenture?
9. If inflation unexpectedly rises by 3%, would a corporation that had recently borrowed money by issuing fixed-rate bonds to pay for a new investment benefit or lose?
10. If wages on average rise at least as fast as inflation, why do people worry about how inflation affects incomes?
11. Identify at least one item that you use regularly whose price has changed significantly.
12. What has been the average annual rate of inflation between 1985 and 2020? What is the long-run average annual rate of inflation over the last century?
13. Between 1985 and 2020, what year had the lowest realized annual rate of inflation in the United States? Why do you think inflation was so low in this particular year?
14. Go to https://www.usinflationcalculator.com/ (https://openstax.org/r/usinflationcalculator). How much money would it take today to purchase what one dollar would have bought in 1950, in 1975, and in your birth year?
15. Are US Treasury bonds truly risk free?
16. At the end of 2020 and the beginning of 2021, coupon rates on long-term T-notes and T-bonds were near historic lows. Further, the federal government was running a historically large budget deficit in an effort to stimulate an economy battered by COVID-19 and to support millions of unemployed workers. Some investment advisers warned that this could be a particularly bad time to invest in government bonds or bonds in general. Why?
17. Which group of securities earned a higher average annual return from 2000 to 2020, T-bonds or Baa bonds? Why do think this was so?
18. Which earned a higher average annual return, a portfolio of T-bonds from 1980 to 2000 or from 2000 to 2020? Why do think this was so?
19. Why is standard deviation of returns a reasonable measure of risk for a portfolio of equity securities?
20. Many popular-press articles claim that growth investing is "clearly better" than value investing or that value investing is "dead." How would you respond to proponents of growth investing after observing Figure 12.15?
21. Over the last 120 years, few countries have achieved the realized rate of returns enjoyed by US equity markets. Does this mean investors should ignore international investments and focus only on domestic markets in an effort to maximize returns?

# Video Activity

## How Private Companies Are Bypassing the IPO Process

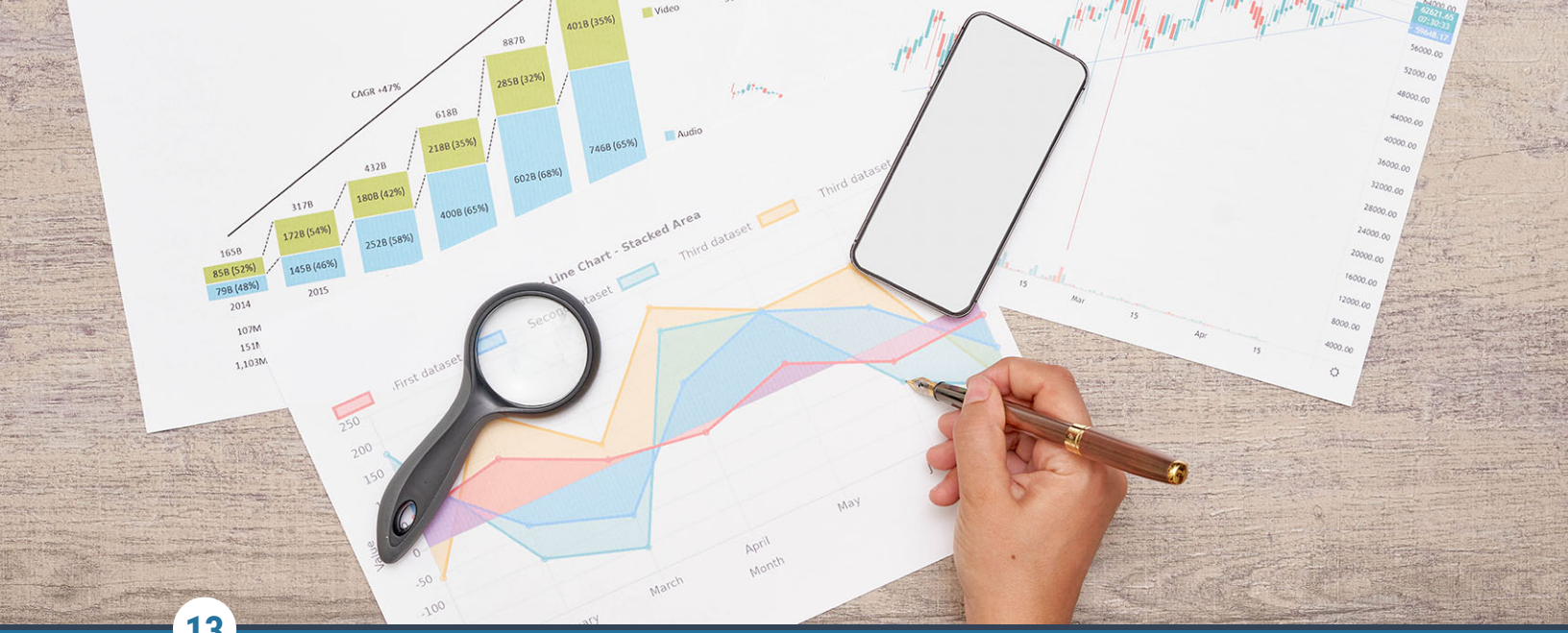
Access multimedia content (http://openstax.org/books/principles-finance/pages/12-video-activity)

1. Can you identify three apparent advantages and three disadvantages for investors in a SPAC (special purpose acquisition company) versus a traditional IPO process?
2. The video concludes with a question about whether SPACs are a current fad doomed to fade away or a new and growing method of publicly financing firms. What do you think? Search for information related to SPACs and proposals for SPAC regulation, and report your conclusion.

## A Secret Meeting and the Birth of the Federal Reserve

Access multimedia content (http://openstax.org/books/principles-finance/pages/12-video-activity)

3. How can an institution like the United State Federal Reserve System prevent bank runs?
4. After the passage of the Federal Reserve Act in 1913 (https://openstax.org/r/federal-reserve-act), the United States has suffered through three great global financial crises: the Great Depression of the 1930s, the Great Recession of 2007–2009 (https://openstax.org/r/the-worlds-most-devastating), and the COVID-19 pandemic of 2020–2021 (https://openstax.org/r/tracking-the-covid-19-recessions-effects). Research one of the latter two crises, and identify and discuss some of the tools used by the Fed to lessen the length and economic severity of the economic hardships. In what ways has this research project supported or changed your opinion about the United States having the Federal Reserve System?




13

# Statistical Analysis in Finance

**Figure 13.1** Graphical displays are used extensively in the finance field. (credit: modification of "Analysing target market" by Marco Verch/flickr CC BY 2.0)

## Chapter Outline


**13.1** Measures of Center
**13.2** Measures of Spread
**13.3** Measures of Position
**13.4** Statistical Distributions
**13.5** Probability Distributions
**13.6** Data Visualization and Graphical Displays
**13.7** The R Statistical Analysis Tool


## Why It Matters

Statistical analysis is used extensively in finance, with applications ranging from consumer concerns such as credit scores, retirement planning, and insurance to business concerns such as assessing stock market volatility and predicting inflation rates. As a consumer, you will make many financial decisions throughout your life, and many of these decisions will be guided by statistical analysis. For example, what is the probability that interest rates will rise over the next year, and how will that affect your decision on whether to refinance a mortgage? In your retirement planning, how should the investment mix be allocated among stocks and bonds to minimize volatility and ensure a high probability for a secure retirement? When running a business, how can statistical quality control methods be used to maintain high quality levels and minimize waste? Should a business make use of consumer focus groups or customer surveys to obtain business intelligence data to improve service levels? These questions and more can benefit from the use and application of statistical methods.

Running a business and tracking its finances is a complex process. From day-to-day activities such as managing inventory levels to longer-range activities such as developing new products or expanding a customer base, statistical methods are a key to business success. For finance considerations, a business must manage risk versus return and optimize investments to ensure shareholder value. Business managers employ a wide range of statistical processes and tools to accomplish these goals. Increasingly, companies are also

interested in data analytics to optimize the value gleaned from business- and consumer-related data, and statistical analysis forms the core of such analytics.

# 13.1 Measures of Center

By the end of this section, you will be able to:

- Calculate various measures of the average of a data set, such as mean, median, mode, and geometric mean.
- Recognize when a certain measure of center is more appropriate to use, such as weighted mean.
- Distinguish among arithmetic mean, geometric mean, and weighted mean.

## Arithmetic Mean

The *average* of a data set is a way of describing location. The most widely used measures of the *center* of a data set are the mean (average), median, and mode. The arithmetic mean is the most common measure of the average. We will discuss the geometric mean later.

Note that the words *mean* and *average* are often used interchangeably. The substitution of one word for the other is common practice. The technical term is *arithmetic mean*, and *average* technically refers only to a center location. Formally, the arithmetic mean is called the first moment of the distribution by mathematicians. However, in practice among non-statisticians, *average* is commonly accepted as a synonym for *arithmetic mean*.

To calculate the **arithmetic mean** value of 50 stock portfolios, add the 50 portfolio dollar values together and divide the sum by 50. To calculate the arithmetic mean for a set of numbers, add the numbers together and then divide by the number of data values.

In statistical analysis, you will encounter two types of data sets: **sample data** and **population data**. Population data represents all the outcomes or measurements that are of interest. Sample data represents outcomes or measurements collected from a subset, or part, of the population of interest.

The notation $\overline{x}$ is used to indicate the sample mean, where the arithmetic mean is calculated based on data taken from a sample. The notation $\sum x$ is used to denote the sum of the data values, and $n$ is used to indicate the number of data values in the sample, also known as the sample size.

The sample mean can be calculated using the following formula:

$$\overline{x} = \frac{\sum x}{n} \quad \textbf{13.1}$$

Finance professionals often rely on averages of Treasury bill auction amounts to determine their value. Table 13.1 lists the Treasury bill auction amounts for a sample of auctions from December 2020.

| Maturity | Amount ($Billions) |
|---|---|
| 4-week T-bills | $32.9 |
| 8-week T-bills | 38.4 |
| 13-week T-bills | 63.1 |
| 26-week T-bills | 59.6 |
| 52-week T-bills | 39.7 |
| **Total** | **$233.7** |

**Table 13.1 United States Treasury Bill Auctions, December 22 and 24, 2020**
(source: Treasury Direct)

To calculate the arithmetic mean of the amount paid for Treasury bills at auction, in billions of dollars, we use the following formula:

$$\overline{x} = \frac{\sum x}{n} = \frac{\$233.7}{5} = \$46.74 \quad \textbf{13.2}$$

## Median

To determine the **median** of a data set, order the data from smallest to largest, and then find the middle value in the ordered data set. For example, to find the median value of 50 portfolios, find the number that splits the data into two equal parts. The portfolio values owned by 25 people will be below the median, and 25 people will have portfolio values above the median. The median is generally a better measure of the average when there are **extreme values** or **outliers** in the data set.

An outlier or extreme value is a data value that is significantly different from the other data values in a data set. The median is preferred when outliers are present because the median is not affected by the numerical values of the outliers.

The ordered data set from Table 13.1 appears as follows:

$$32.9,\ 38.4,\ 39.7,\ 59.6,\ 63.1 \quad \textbf{13.3}$$

The middle value in this ordered data set is the third data value, which is 39.7. Thus, the median is $39.7 billion.

You can quickly find the location of the median by using the expression $\frac{n+1}{2}$. The variable $n$ represents the total number of data values in the sample. If $n$ is an odd number, the median is the middle value of the data values when ordered from smallest to largest. If $n$ is an even number, the median is equal to the two middle values of the ordered data values added together and divided by 2. In the example from Table 13.1, there are five data values, so $n = 5$. To identify the position of the median, calculate $\frac{n+1}{2}$, which is $\frac{5+1}{2}$, or 3. This indicates that the median is located in the third data position, which corresponds to the value 39.7.

As mentioned earlier, when outliers are present in a data set, the mean can be nonrepresentative of the center of the data set, and the median will provide a better measure of center. The following Think It Through example illustrates this point.

### THINK IT THROUGH

#### Finding the Measure of Center

Suppose that in a small village of 50 people, one person earns a salary of $5 million per year, and the other 49 individuals each earn $30,000. Which is the better measure of *center*: the mean or the median?

**Solution:**

The *mean*, in dollars, would be arrived at mathematically as follows:

$$\overline{x} = \frac{5{,}000{,}000 + 49(30{,}000)}{50} = 129{,}400 \quad \textbf{13.4}$$

However, the *median* would be $30,000. There are 49 people who earn $30,000 and one person who earns $5,000,000.

The median is a better measure of the "average" than the mean because 49 of the values are $30,000 and one is $5,000,000. The $5,000,000 is an outlier. The $30,000 gives us a better sense of the middle of the data set.

## Mode

Another measure of center is the **mode**. The mode is the most frequent value. There can be more than one mode in a data set as long as those values have the same frequency and that frequency is the highest. A data set with two modes is called *bimodal*. For example, assume that the weekly closing stock price for a technology stock, in dollars, is recorded for 20 consecutive weeks as follows:

$$50,\ 53,\ 59,\ 59,\ 63,\ 63,\ 72,\ 72,\ 72,\ 72,\ 72,\ 76,\ 78,\ 81,\ 83,\ 84,\ 84,\ 84,\ 90,\ 93 \quad \textbf{13.5}$$

To find the mode, determine the most frequent score, which is 72. It occurs five times. Thus, the mode of this data set is 72. It is helpful to know that the most common closing price of this particular stock over the past 20 weeks has been $72.00.

## Geometric Mean

The arithmetic mean, median, and mode are all measures of the *center* of a data set, or the *average*. They are all, in their own way, trying to measure the common point within the data—that which is "normal." In the case of the arithmetic mean, this is accomplished by finding the value from which all points are equal linear distances. We can imagine that all the data values are combined through addition and then distributed back to each data point in equal amounts.

The **geometric mean** redistributes not the sum of the values but their product. It is calculated by multiplying all the individual values and then redistributing them in equal portions such that the total product remains the same. This can be seen from the formula for the geometric mean, $\tilde{x}$ (pronounced *x*-tilde):

$$\tilde{x} = \sqrt[n]{x_1 \cdot x_2 \cdots x_n} \quad \textbf{13.6}$$

The geometric mean is relevant in economics and finance for dealing with growth—of markets, in investments, and so on. For an example of a finance application, assume we would like to know the equivalent percentage growth rate over a five-year period, given the yearly growth rates for the investment.

For a five-year period, the annual rate of return for a certificate of deposit (CD) investment is as follows: 3.21%, 2.79%, 1.88%, 1.42%, 1.17%. Find the single percentage growth rate that is equivalent to these five annual consecutive rates of return. The geometric mean of these five rates of return will provide the solution. To calculate the geometric mean for these values (which must all be positive), first multiply[1] the rates of return together—after adding 1 to the decimal equivalent of each interest rate—and then take the *n*th root of the product. We are interested in calculating the equivalent overall rate of return for the yearly rates of return, which can be expressed as 1.0321, 1.0279, 1.0188, 1.0142, and 1.0117:

$$\tilde{x} = \sqrt[n]{x_1 \cdot x_2 \cdots x_n} = \sqrt[5]{1.0321 \cdot 1.0279 \cdot 1.0188 \cdot 1.0142 \cdot 1.0117} = 1.0209 \quad \textbf{13.7}$$

Based on the geometric mean, the equivalent annual rate of return for this time period is 2.09%.

LINK TO LEARNING

Arithmetic versus Geometric Means

In this video on arithmetic versus geometric means (https://openstax.org/r/arithmetic-versus-geometric), the returns of the S&P 500 are tracked using an arithmetic mean versus a geometric mean, and the difference between these two measurements is discussed.

## Weighted Mean

A **weighted mean** is a measure of the center, or average, of a data set where each data value is assigned a corresponding weight. A common financial application of a weighted mean is in determining the average price

1 In this chapter, the interpunct dot will be used to indicate the multiplication operation in formulas.

per share for a certain stock when the stock has been purchased at different points in time and at different share prices.

To calculate a weighted mean, create a table with the data values in one column and the weights in a second column. Then create a third column in which each data value is multiplied by each weight on a row-by-row basis. Then, the weighted mean is calculated as the sum of the results from the third column divided by the sum of the weights.

THINK IT THROUGH

### Calculating the Weighted Mean

Assume your portfolio contains 1,000 shares of XYZ Corporation, purchased on three different dates, as shown in Table 13.2. Calculate the weighted mean of the purchase price for the 1,000 shares.

| Date Purchased | Purchase Price ($) | Number of Shares Purchased | Price ($) Times Number of Shares |
|---|---|---|---|
| January 17 | 78 | 200 | 15,600 |
| February 10 | 122 | 300 | 36,600 |
| March 23 | 131 | 500 | 65,500 |
| **Total** | **NA** | **1,000** | **117,700** |

**Table 13.2 1,000 Shares of XYZ Corporation**

**Solution:**

In this example, the purchase price is weighted by the number of shares. The sum of the third column is $117,700, and sum of the weights is 1,000. The weighted mean is calculated as $117,700 divided by 1,000, which is $117.70.

Thus, the average cost per share for the 1,000 shares of XYZ Corporation is $117.70.

## 13.2 Measures of Spread

By the end of this section, you will be able to:

- Define and calculate standard deviation for a data set.
- Define and calculate variance for a data set.
- Explain the relationship between standard deviation and variance.

### Standard Deviation

An important characteristic of any set of data is the variation in the data. In some data sets, the data values are concentrated close to the mean; in other data sets, the data values are more widely spread out. For example, an investor might examine the yearly returns for Stock A, which are 1%, 2%, -1%, 0%, and 3%, and compare them to the yearly returns for Stock B, which are -9%, 2%, 15%, -5%, and 0%.

Notice that Stock B exhibits more volatility in yearly returns than Stock A. The investor may want to quantify this variation in order to make the best investment decisions for a particular investment objective.

The most common measure of variation, or spread, is standard deviation. The **standard deviation** of a data set is a measure of how far the data values are from their mean. A standard deviation

- provides a numerical measure of the overall amount of variation in a data set; and

- can be used to determine whether a particular data value is close to or far from the mean.

*The standard deviation provides a measure of the overall variation in a data set.* The standard deviation is always positive or zero. It is small when the data values are all concentrated close to the mean, exhibiting little variation or spread. It is larger when the data values are more spread out from the mean, exhibiting more variation.

Suppose that we are studying the variability of two different stocks, Stock A and Stock B. The average stock price for both stocks is $5. For Stock A, the standard deviation of the stock price is 2, whereas the standard deviation for Stock B is 4. Because Stock B has a higher standard deviation, we know that there is more variation in the stock price for Stock B than in the price for Stock A.

There are two different formulas for calculating standard deviation. Which formula to use depends on whether the data represents a sample or a population. The notation $s$ is used to represent the sample standard deviation, and the notation $\sigma$ is used to represent the population standard deviation. In the formulas shown below, $\bar{x}$ is the sample mean, $\mu$ is the population mean, $n$ is the sample size, and $N$ is the population size.

Formula for the sample standard deviation:

$$s = \sqrt{\frac{\sum(x - \bar{x})^2}{n - 1}} \quad \textbf{13.8}$$

Formula for the population standard deviation:

$$\sigma = \sqrt{\frac{\sum(x - \mu)^2}{N}} \quad \textbf{13.9}$$

## Variance

**Variance** also provides a measure of the spread of data values. The variance of a data set measures the extent to which each data value differs from the mean. The more the individual data values differ from the mean, the larger the variance. Both the standard deviation and the variance provide similar information.

In a finance application, variance can be used to determine the volatility of an investment and therefore to help guide financial decisions. For example, a more cautious investor might opt for investments with low volatility.

Similar to standard deviation, the formula used to calculate variance also depends on whether the data is collected from a sample or a population. The notation $s^2$ is used to represent the sample variance, and the notation $\sigma^2$ is used to represent the population variance.

Formula for the sample variance:

$$s^2 = \frac{\sum(x - \bar{x})^2}{n - 1} \quad \textbf{13.10}$$

Formula for the population variance:

$$\sigma^2 = \frac{\sum(x - \mu)^2}{N} \quad \textbf{13.11}$$

This is the method to calculate standard deviation and variance for a sample:

1. First, find the mean $\bar{x}$ of the data set by adding the data values and dividing the sum by the number of data values.
2. Set up a table with three columns, and in the first column, list the data values in the data set.
3. For each row, subtract the mean from the data value $(x - \bar{x})$, and enter the difference in the second

column. Note that the values in this column may be positive or negative. The sum of the values in this column will be zero.

4. In the third column, for each row, square the value in the second column. So this third column will contain the quantity (Data Value – Mean)$^2$ for each row. We can write this quantity as $(x - \overline{x})^2$. Note that the values in this third column will always be positive because they represent a squared quantity.
5. Add up all the values in the third column. This sum can be written as $\sum (x - \overline{x})^2$.
6. Divide this sum by the quantity ($n$ – 1), where $n$ is the number of data points. We can write this as $\frac{\sum (x - \overline{x})^2}{n - 1}$.
7. This result is called the sample variance, denoted by $s^2$. Thus, the formula for the sample variance is $s^2 = \frac{\sum (x - \overline{x})^2}{n - 1}$.
8. Now take the square root of the sample variance. This value is the sample standard deviation, called $s$. Thus, the formula for the sample standard deviation is $s = \sqrt{\frac{\sum (x - \overline{x})^2}{n - 1}}$.
9. Round-off rule: The sample variance and sample standard deviation are typically rounded to one more decimal place than the data values themselves.

## THINK IT THROUGH

### Finding Standard Deviation and Variance

A brokerage firm advertises a new financial analyst position and receives 210 applications. The ages of a sample of 10 applicants for the position are as follows:

$$40,\ 36,\ 44,\ 51,\ 54,\ 55,\ 39,\ 47,\ 44,\ 50 \quad \textbf{13.12}$$

The brokerage firm is interested in determining the standard deviation and variance for this sample of 10 ages.

**Solution:**

Find the sample variance and sample standard deviation by creating a table with three columns (see Table 13.3).

1. The data set is 40, 36, 44, 51, 54, 55, 39, 47, 44, 50.
2. This data set has 10 data values. Thus, $n = 10$.
3. The mean is calculated as $\overline{x} = 46$.
4. Column 1 will contain the data values themselves.
5. Column 2 will contain $x - \overline{x}$.
6. Column 3 will contain $(x - \overline{x})^2$.

| Column 1 $x$ | Column 2 $(x - \overline{x})$ | Column 3 $(x - \overline{x})^2$ |
|---|---|---|
| 40 | $40 - 46 = -6$ | $(-6)^2 = 36$ |
| 36 | $36 - 46 = -10$ | $(-10)^2 = 100$ |
| 44 | $44 - 46 = -2$ | $(-2)^2 = 4$ |
| 51 | $51 - 46 = 5$ | $(5)^2 = 25$ |
| 54 | $54 - 46 = 8$ | $(8)^2 = 64$ |

**Table 13.3 Calculations for Standard Deviation for**

| Column 1 $x$ | Column 2 $(x - \bar{x})$ | Column 3 $(x - \bar{x})^2$ |
|---|---|---|
| 55 | $55 - 46 = 9$ | $(9)^2 = 81$ |
| 39 | $39 - 46 = -7$ | $(-7)^2 = 49$ |
| 47 | $47 - 46 = 1$ | $(1)^2 = 1$ |
| 44 | $44 - 46 = -2$ | $(-2)^2 = 4$ |
| 50 | $50 - 46 = 4$ | $(4)^2 = 16$ |
| | **Sum = 0** | **Sum = 380** |

**Table 13.3 Calculations for Standard Deviation for Age Example**

7. To calculate the sample variance, use the sample variance formula:

$$s^2 = \frac{\sum (x - \bar{x})^2}{n - 1} = \frac{380}{10 - 1} = \frac{380}{9} \approx 42.2 \quad \textbf{13.13}$$

8. To calculate the sample standard deviation, use the sample standard deviation formula:

$$s = \sqrt{\frac{\sum (x - \bar{x})^2}{n - 1}} = \sqrt{\frac{380}{9}} \approx 6.5 \quad \textbf{13.14}$$

As the above example illustrates, calculating the variance and standard deviation is a tedious process. A financial calculator can calculate statistical measurements such as mean and standard deviation quickly and efficiently.

There are two steps needed to perform statistical calculations on the calculator:

1. Enter the data in the calculator using the [DATA] function, which is located above the 7 key.
2. Access the statistical results provided by the calculator using the [STAT] function, which is located above the 8 key.

Follow the steps in Table 13.4 to calculate mean and standard deviation using the financial calculator. The ages data set from the Think It Through example above is used again here: 40, 36, 44, 51, 54, 55, 39, 47, 44, 50.

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 1 | Enter [DATA] entry mode | 2ND [DATA] | X01 | 0.00 |
| 2 | Clear any previous data | 2ND [CLR WORK] | X01 | 0.00 |
| 3 | Enter first data value of 40 | 40 ENTER | X01 = | 40.00 |
| 4 | Move to next data entry | ↓ | Y01 = | 1.00 |
| 5 | Move to next data entry | ↓ | X02 | 0.0 |
| 6 | Enter second data value of 36 | 36 ENTER | X02 = | 36.00 |
| 7 | Move to next data entry | ↓ | Y02 = | 1.00 |
| 8 | Move to next data entry | ↓ | X03 | 0.00 |

**Table 13.4 Calculator Steps for Mean and Standard Deviation**[2]

2 The specific financial calculator in these examples is the Texas Instruments BA II Plus™ Professional model, but you can use other financial calculators for these types of calculations.

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 9 | Enter third data value of 44 | 44 ENTER | X03 = | 44.00 |
| 10 | Move to next data entry | ↓ | Y03 = | 1.00 |
| 11 | Continue to enter remaining data values | | | |
| 12 | Enter [STAT] mode | 2nd [STAT] | LIN | |
| 13 | Move to first statistical result | ↓ | $n$ = | 10.00 |
| 14 | Move to next statistical result | ↓ | $\overline{x}$ = | 46.00 |
| 15 | Move to next statistical result | ↓ | $Sx$ = | 6.50 |

**Table 13.4 Calculator Steps for Mean and Standard Deviation**[2]

From the statistical results, the mean is shown as 46, and the sample standard deviation is shown as 6.50.

Excel provides a similar analysis using the built-in functions =AVERAGE (for the mean) and =STDEV.S (for the sample standard deviation). To calculate these statistical results in Excel, enter the data values in a column. Let's assume the data values are placed in cells A2 through A11. In any cell, type the Excel command =AVERAGE(A2:A11) and press enter. Excel will calculate the arithmetic mean in this cell. Then, in any other cell, type the Excel command =STDEV.S(A2:A11) and press enter. Excel will calculate the sample standard deviation in this cell. Figure 13.2 shows the mean and standard deviation for the 10 ages.

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | **Ages** | | | | |
| 2 | 40 | | | | |
| 3 | 36 | | Excel command to calculate sample mean: | | |
| 4 | 44 | | **=AVERAGE(A2:A11)** | | |
| 5 | 51 | | | | |
| 6 | 54 | | Result: | 46 | |
| 7 | 55 | | | | |
| 8 | 39 | | Excel command to calculate sample standard deviation: | | |
| 9 | 47 | | **=STDEV.S(A2:A11)** | | |
| 10 | 44 | | | | |
| 11 | 50 | | Result: | 6.50 | |

**Figure 13.2 Mean and Standard Deviation in Excel.**

## Relationship between Standard Deviation and Variance

In the formulas shown above for variance and standard deviation, notice that the variance is the square of the standard deviation, and the standard deviation is the square root of the variance.

Once you have calculated one of these values, you can directly calculate the other value. For example, if you know the standard deviation of a data set is 12.5, you can calculate the variance by squaring this standard deviation. The variance is then $12.5^2$, which is 156.25.

In the same way, if you know the value of the variance, you can determine the standard deviation by calculating the square root of the variance. For example, if the variance of a data set is known to be 31.36, then the standard deviation can be calculated as the square root of 31.36, which is 5.6.

One disadvantage of using the variance is that the variance is measured in *square units*, which are different from the units in the data set. For example, if the data set consists of ages measured in years, then the

variance would be measured in years squared, which can be confusing. The standard deviation is measured in the same units as the original data set, and thus the standard deviation is used more commonly than the variance to measure the spread of a data set.

# 13.3 Measures of Position

By the end of this section, you will be able to:

- Define and calculate *z*-scores for a measurement.
- Define and calculate quartiles and percentiles for a data set.
- Use quartiles as a method to detect outliers in a data set.

## *z*-Scores

A ***z*-score**, also called a ***z*-value**, is a measure of the position of an entry in a data set. It represents the number of standard deviations by which a data value differs from the mean. For example, suppose that in a certain year, the rates of return for various technology-focused mutual funds are examined, and the mean return is 7.8% with a standard deviation of 2.3%. A certain mutual fund publishes its rate of return as 12.4%. Based on this rate of return of 12.4%, we can calculate the relative standing of this mutual fund compared to the other technology-focused mutual funds. The corresponding *z*-score of a measurement considers the given measurement in relation to the mean and standard deviation for the entire population.

The formula for a *z*-score calculation is as follows:

$$z = \frac{x - \mu}{\sigma} \tag{13.15}$$

where $x$ is the measurement, $\mu$ is the mean, and $\sigma$ is the standard deviation.

THINK IT THROUGH

### Interpreting a *z*-Score

A certain technology-based mutual fund reports a rate of return of 12.4% for a certain year, while the mean rate of return for comparable funds is 7.8% and the standard deviation is 2.3%. Calculate and interpret the *z*-score for this particular mutual fund.

**Solution:**

In this example, the measurement $x = 12.4$, $\mu = 7.8$, and $\sigma = 2.3$. Using the *z*-score formula, the calculation is performed as follows:

$$z = \frac{x - \mu}{\sigma} = \frac{12.4 - 7.8}{2.3} = \frac{4.6}{2.3} = 2 \tag{13.16}$$

The resulting *z*-score indicates the number of standard deviations by which a particular measurement is above or below the mean. In this example, the rate of return for this particular mutual fund is 2 standard deviations above the mean, indicating that this mutual fund generated a significantly better rate of return than all other technology-based mutual funds for the same time period.

## Quartiles and Percentiles

If a person takes an IQ test, their resulting score might be reported as in the *87th percentile*. This percentile indicates the person's relative performance compared to others taking the IQ test. A person scoring in the 87th percentile has an IQ score higher than 87% of all others taking the test. This is the same as saying that the person is in the top 13% of all people taking the IQ test.

Common measures of location are **quartiles** and **percentiles**. Quartiles are special percentiles. The first quartile, $Q_1$, is the same as the 25th percentile, and the third quartile, $Q_3$, is the same as the 75th percentile. The median, $M$, is called both the second quartile and the 50th percentile.

To calculate quartiles and percentiles, the data must be ordered from smallest to largest. Quartiles divide ordered data into quarters. Percentiles divide ordered data into hundredths. If you score in the 90th percentile of an exam, that does not necessarily mean that you receive 90% on the test. It means that 90% of the test scores are the same as or less than your score and the remaining 10% of the scores are the same as or greater than your score.

Percentiles are useful for comparing values. In a finance example, a mutual fund might report that the performance for the fund over the past year was in the 80th percentile of all mutual funds in the peer group. This indicates that the fund performed better than 80% of all other funds in the peer group. This also indicates that 20% of the funds performed better than this particular fund.

Quartiles are values that separate the data into quarters. Quartiles may or may not be part of the data. To find the quartiles, first find the median, or second quartile. The first quartile, $Q_1$, is the middle value, or median, of the lower half of the data, and the third quartile, $Q_3$, is the middle value of the upper half of the data. As an example, consider the following ordered data set, which represents the rates of return for a group of technology-based mutual funds in a certain year:

$$5.4,\ 6.0,\ 6.3,\ 6.8,\ 7.1,\ 7.2,\ 7.4,\ 7.5,\ 7.9,\ 8.2,\ 8.7 \tag{13.17}$$

The median, or second quartile, is the middle value in this data set, which is 7.2. Notice that 50% of the data values are below the median, and 50% of the data values are above the median. The lower half of the data values are 5.4, 6.0, 6.3, 6.8, 7.1 Notice that these are the data values below the median. The upper half of the data values are 7.4, 7.5, 7.9, 8.2, 8.7, which are the data values above the median.)

To find the first quartile, $Q_1$, locate the middle value of the lower half of the data. The middle value of the lower half of the data set is 6.3. Notice that one-fourth, or 25%, of the data values are below this first quartile, and 75% of the data values are above this first quartile.

To find the third quartile, $Q_3$, locate the middle value of the upper half of the data. The middle value of the upper half of the data set is 7.9. Notice that one-fourth, or 25%, of the data values are above this third quartile, and 75% of the data values are below this third quartile.

The **interquartile range (IQR)** is a number that indicates the spread of the middle half, or the middle 50%, of the data. It is the difference between the third quartile, $Q_3$, and the first quartile, $Q_1$.

$$IQR = Q_3 - Q_1 \tag{13.18}$$

In the above example, the IQR can be calculated as

$$IQR = Q_3 - Q_1 = 7.9 - 6.3 = 1.6 \tag{13.19}$$

## Outlier Detection

Quartiles and the IQR can be used to flag possible outliers in a data set. For example, if most employees at a company earn about $50,000 and the CEO of the company earns $2.5 million, then we consider the CEO's salary to be an outlier data value because is significantly different from all the other salaries in the data set. An outlier data value can also be a value much lower than the other data values, so if one employee only makes $15,000, then this employee's low salary might also be considered an outlier.

To detect outliers, use the quartiles and the IQR to calculate a lower and an upper bound for outliers. Then any data values below the lower bound or above the upper bound will be flagged as outliers. These data values should be further investigated to determine the nature of the outlier condition.

To calculate the lower and upper bounds for outliers, use the following formulas:

$$\text{Lower Bound for Outliers} = Q_1 - (1.5 \cdot IQR) \quad 13.20$$

$$\text{Upper Bound for Outliers} = Q_3 + (1.5 \cdot IQR) \quad 13.21$$

THINK IT THROUGH

### Calculating the IQR

Calculate the IQR for the following 13 portfolio values, and determine if any of the portfolio values are potential outliers. Data values are in dollars.

389,950; 230,500; 158,000; 479,000; 639,000; 114,950; 5,500,000; 387,000; 659,000; 529,000; 575,000; 488,800; 1,095,000

**Solution:**

Order the data from smallest to largest.

114,950; 158,000; 230,500; 387,000; 389,950; 479,000; 488,800; 529,000; 575,000; 639,000; 659,000; 1,095,000; 5,500,000

$$M = 488{,}800 \quad 13.22$$

$$Q_1 = \frac{230{,}500 + 387{,}000}{2} = 308{,}750 \quad 13.23$$

$$Q_3 = \frac{639{,}000 + 659{,}000}{2} = 649{,}000 \quad 13.24$$

$$IQR = 649{,}000 - 308{,}750 = 340{,}250 \quad 13.25$$

$$(1.5)(IQR) = (1.5)(340{,}250) = 510{,}375 \quad 13.26$$

$$\text{Lower Bound} = Q_1 - (1.5)(IQR) = 308{,}750 - 510{,}375 = -201{,}625 \quad 13.27$$

$$\text{Upper Bound} = Q_3 + (1.5)(IQR) = 649{,}000 + 510{,}375 = 1{,}159{,}375 \quad 13.28$$

No portfolio value price is less than -201,625. However, 5,500,000 is more than 1,159,375. Therefore, the portfolio value of 5,500,000 is a potential outlier. This is important because the presence of outliers could potentially indicate data errors or some other anomalies in the data set that should be investigated.

## 13.4 Statistical Distributions

By the end of this section, you will be able to:

- Construct and interpret a frequency distribution.
- Apply and evaluate probabilities using the normal distribution.
- Apply and evaluate probabilities using the exponential distribution.

### Frequency Distributions

A **frequency distribution** provides a method to organize and summarize a data set. For example, we might be interested in the spread, center, and shape of the data set's distribution. When a data set has many data values, it can be difficult to see patterns and come to conclusions about important characteristics of the data. A frequency distribution allows us to organize and tabulate the data in a summarized way and also to create graphs to help facilitate an interpretation of the data set.

To create a basic frequency distribution, set up a table with three columns. The first column will show the intervals for the data, and the second column will show the frequency of the data values, or the count of how many data values fall within each interval. A third column can be added to include the relative frequency for each row, which is calculated by taking the frequency for that row and dividing it by the sum of all the

frequencies in the table.

## THINK IT THROUGH

### Graphing Demand and Supply

A financial consultant at a brokerage firm records the portfolio values for 20 clients, as shown in Table 13.5, where the portfolio values are shown in thousands of dollars.

| | | | | |
|---|---|---|---|---|
| 278 | 318 | 422 | 577 | 618 |
| 735 | 798 | 864 | 903 | 944 |
| 1,052 | 1,099 | 1,132 | 1,180 | 1,279 |
| 1,365 | 1,471 | 1,572 | 1,787 | 1,905 |

**Table 13.5 Portfolio Values for 20 Clients at a Brokerage Firm ($000s)**

Create a frequency distribution table using the following intervals for the portfolio values:

0–299 **13.29**

300–599 **13.30**

600–899 **13.31**

900–1,199 **13.32**

1,200–1,499 **13.33**

1,500–1,799 **13.34**

1,800–2,099 **13.35**

**Solution:**

Create a table where the intervals for portfolio value are listed in the first column. For this example, it was decided to create a frequency distribution table with seven rows and a class width set to 300. The class width is the distance from the start of one interval to the start of the next interval in the subsequent row. For example, the interval for the second row starts at 300, the interval for the third row starts at 600, and so on.

In the second column, record the frequency, or the number of data values that fall within the interval, for each row. For example, for the first row, count the number of data values that fall between 0 and 299. Because there is only one data value (278) that falls in this interval, the corresponding frequency is 1. For the second row, there are 3 data values that fall between 300 and 599 (318, 422, and 577). Thus, the frequency for the second row is 3.

For the third column, called relative frequency, take the frequency for each row and divide it by the sum of the frequencies, which is 20. For example, in the first row, the relative frequency will be 1 divided by 20, which is 0.05. The relative frequency for the second row will be 3 divided by 20, which is 0.15. The resulting frequency distribution table is shown in Table 13.6.

| Portfolio Value Interval ($000s) | Frequency | Relative Frequency |
|---|---|---|
| 0–299 | 1 | 0.05 |
| 300–599 | 3 | 0.15 |
| 600–899 | 4 | 0.20 |
| 900–1,199 | 6 | 0.30 |
| 1,200–1,499 | 3 | 0.15 |
| 1,500–1,799 | 2 | 0.10 |
| 1,800–2,099 | 1 | 0.05 |

**Table 13.6 Frequency Distribution of Portfolio Values for 20 Clients at a Brokerage Firm ($000s)**

The frequency table indicates that most customers have portfolio values between $300,000 and $599,000, as this row in the table shows the highest frequency. Very few customers have portfolios with a value below $299,000 or above $1,800,000, as these frequencies in these rows are very low. Because the highest frequency corresponds to the row in the middle of the table and the frequencies decrease with each interval below and above this middle interval, the frequency table indicates that this distribution is a bell-shaped distribution.

The following is a summary of how to create a frequency distribution table (for integer data). Note that the number of classes in a frequency table is the same as the number of rows in the table.

1. Calculate the class width using the formula $\text{Class Width} = \frac{\text{Max} - \text{Min}}{\text{Number of Classes}}$
   - Note: For integer data, round the class width up to the next whole number.
2. Create a table with a number of rows equal to the number of classes. Create columns for Lower Class Limit, Upper Class Limit, Frequency, and Relative Frequency.
3. Set the lower class limit for the first row equal to the minimum value from the data set, or some other appropriate value.
4. Calculate the lower class limit for the second row by adding the class width to the lower class limit from the first row. Add the class width to each new lower class limit to calculate the lower class limit for each subsequent row.
5. The upper class limit for each row is 1 less than the lower class limit of the subsequent row. You can also add the class width to each upper class limit to determine the upper class limit for the subsequent row.
6. Record the frequency for each row by counting how many data values fall between the lower class limit and the upper class limit for that row.
7. Calculate the relative frequency for each row by taking the frequency for that row and dividing by the total number of data values.

## Normal Distribution

The normal probability density function, a continuous distribution, is the most important of all the distributions. The **normal distribution** is applicable when the frequency of data values decreases with each class above and below the mean. The normal distribution can be applied to many examples from the finance industry, including average returns for mutual funds over a certain time period, portfolio values, and others. The normal distribution has two parameters, or numerical descriptive measures: the mean, $\mu$, and the standard deviation, $\sigma$. The variable $x$ represents the quantity being measured whose data values have a normal distribution.

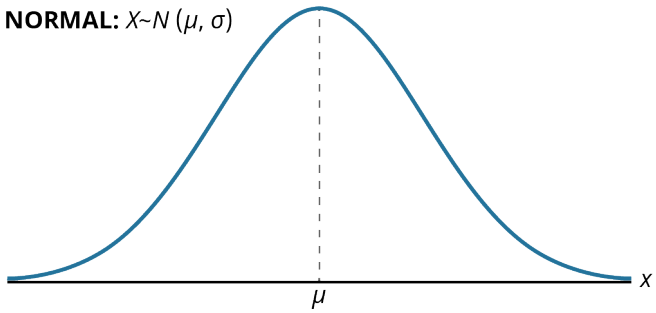



**Figure 13.3 Graph of the Normal Distribution**

The curve in Figure 13.3 is symmetric about a vertical line drawn through the mean, $\mu$. The mean is the same as the median, which is the same as the mode, because the graph is symmetric about $\mu$. As the notation indicates, the normal distribution depends only on the mean and the standard deviation. Because the area under the curve must equal 1, a change in the standard deviation, $\sigma$, causes a change in the shape of the normal curve; the curve becomes fatter and wider or skinnier and taller depending on $\sigma$. A change in $\mu$ causes the graph to shift to the left or right. This means there are an infinite number of normal probability distributions.

To determine probabilities associated with the normal distribution, we find specific areas under the normal curve, and this is further discussed in Apply the Normal Distribution in Financial Contexts. For example, suppose that at a financial consulting company, the mean employee salary is $60,000 with a standard deviation of $7,500. A normal curve can be drawn to represent this scenario, in which the mean of $60,000 would be plotted on the horizontal axis, corresponding to the peak of the curve. Then, to find the probability that an employee earns more than $75,000, you would calculate the area under the normal curve to the right of the data value $75,000.

Excel uses the following command to find the area under the normal curve to the *left* of a specified value:

```
=NORM.DIST(XVALUE, MEAN, STANDARD_DEV, TRUE)
```

For example, at the financial consulting company mentioned above, the mean employee salary is $60,000 with a standard deviation of $7,500. To find the probability that a random employee's salary is less than $55,000 using Excel, this is the command you would use:

```
=NORM.DIST(55000, 60000, 7500, TRUE)

Result: 0.25249
```

Thus, there is a probability of about 25% that a random employee has a salary less than $55,000.

## Exponential Distribution

The **exponential distribution** is often concerned with the amount of time until some specific event occurs. For example, a finance professional might want to model the time to default on payments for company debt holders.

An exponential distribution is one in which there are fewer large values and more small values. For example, marketing studies have shown that the amount of money customers spend in a store follows an exponential distribution. There are more people who spend small amounts of money and fewer people who spend large amounts of money.

Exponential distributions are commonly used in calculations of product reliability, or the length of time a product lasts. The random variable for the exponential distribution is continuous and often measures a passage of time, although it can be used in other applications. Typical questions may be, What is the

probability that some event will occur between $x_1$ hours and $x_2$ hours? or What is the probability that the event will take more than $x_1$ hours to perform? In these examples, the random variable $x$ equals either the time between events or the passage of time to complete an action (e.g., wait on a customer). The probability density function is given by

$$f(x) = \frac{1}{\mu} e^{-\frac{1}{\mu}x} \quad \textbf{13.36}$$

where $\mu$ is the historical average of the values of the random variable (e.g., the historical average waiting time). This probability density function has a mean and standard deviation of $\frac{1}{\mu}$.

To determine probabilities associated with the exponential distribution, we find specific areas under the exponential distribution curve. The following formula can be used to calculate the area under the exponential curve to the left of a certain value:

$$F(x) = 1 - e^{-\frac{1}{\mu}x} \quad \textbf{13.37}$$

THINK IT THROUGH

### Calculating Probability

At a financial company, the mean time between incoming phone calls is 45 seconds, and the time between phone calls follows an exponential distribution, where the time is measured in minutes. Calculate the probability of having 2 minutes or less between phone calls.

**Solution:**

To calculate the probability, find the area under the curve to the left of 1 minute. The mean time is given as 45 seconds, which is the same as 0.75 minutes. The probability can then be calculated as follows:

$$\text{Probability} = 1 - e^{-\frac{1}{0.75}(1)} = 0.736 \quad \textbf{13.38}$$

## 13.5 Probability Distributions

By the end of this section, you will be able to:

- Calculate portfolio weights in an investment.
- Calculate and interpret the expected values.
- Apply the normal distribution to characterize average and standard deviation in financial contexts.

### Calculate Portfolio Weights

In many financial analyses, the **weightings** by asset category in a **portfolio** are a key index used to assess if the portfolio is meeting allocation metrics. For example, an investor approaching retirement age may wish to shift assets in a portfolio to more conservative and lower-volatility investments. Weightings can be calculated in several different ways—for example, based on individual stocks in a portfolio or on various sectors in a portfolio. Weightings can also be calculated based on number of shares or the value of shares of a stock.

To calculate a weighting in a portfolio based on value, take the value of the particular investment and divide it by the total value of the overall portfolio. As an example, consider an individual's retirement account for which the desired portfolio weighting is determined to be 40% stocks, 50% bonds, and 10% cash equivalents. Table 13.7 shows the current assets in the individual's portfolio, broken out according to stocks, bonds, and cash equivalents.

| Asset | Value ($) |
|---|---|
| Stock A | 134,000 |
| Stock B | 172,000 |
| Bond C | 38,000 |
| Bond D | 102,000 |
| Bond E | 96,000 |
| Cash in CDs | 35,700 |
| Cash in savings | 22,500 |
| **Total Value** | **600,200** |

**Table 13.7 Portfolio Assets in Stocks, Bonds, and Cash Equivalents**

To determine the weighting in this portfolio for stocks, bonds, and cash, take the total value for each category and divide it by the total value of the entire portfolio. These results are summarized in Table 13.8. Notice that the portfolio weightings shown in the table do not match the target, or desired, allocation weightings of 40% stocks, 50% bonds, and 10% cash equivalents.

| Asset Category | Category Value ($) | Portfolio Weighting |
|---|---|---|
| Stocks | 306,000 | $\frac{306,000}{600,200} = 0.51$ |
| Bonds | 236,000 | $\frac{236,000}{600,200} = 0.39$ |
| Cash | 58,200 | $\frac{58,200}{600,200} = 0.10$ |
| **Total Value** | **600,200** | |

**Table 13.8 Portfolio Weightings for Stocks, Bonds, and Cash Equivalents**

Portfolio rebalancing is a process whereby the investor buys or sells assets to achieve the desired portfolio weightings. In this example, the investor could sell approximately 10% of the stock assets and purchase bonds with the proceeds to align the asset categories to the desired portfolio weightings.

## Calculate and Interpret Expected Values

A **probability distribution** is a mathematical function that assigns probabilities to various outcomes. For example, we can assign a probability to the outcome of a certain stock increasing in value or decreasing in value. One application of a probability distribution function is determining **expected value**.

In many financial situations, we are interested in determining the expected value of the return on a particular investment or the expected return on a portfolio of multiple investments. To calculate expected returns, we formulate a probability distribution and then use the following formula to calculate expected value:

$$\text{Expected Value} = P_1 \cdot R_1 + P_2 \cdot R_2 + P_3 \cdot R_3 + \ldots + P_n \cdot R_n \quad \textbf{13.39}$$

where $P_1$, $P_2$, $P_3$, $\cdots$ $P_n$ are the probabilities of the various returns and $R_1$, $R_2$, $R_3$, $\cdots$ $R_n$ are the various rates of return.

In essence, expected value is a weighted mean where the probabilities form the weights. Typically, these values for $P_n$ and $R_n$ are derived from historical data. As an example, consider a probability distribution for potential returns for United Airlines common stock. Assume that from historical data gathered over a certain time period, there is a 15% probability of generating a 12% return on investment for this stock, a 35%

probability of generating a 5% return, a 25% probability of generating a 2% return, a 14% probability of generating a 5% loss, and an 11% probability of resulting in a 10% loss. This data can be organized into a probability distribution table as seen in Table 13.9.

Using the expected value formula, the expected return of United Airlines stock over an extended period of time follows:

$$\text{Expected Value} = P_1 \cdot R_1 + P_2 \cdot R_2 + P_3 \cdot R_3 + \ldots + P_n \cdot R_n \quad \textbf{13.40}$$

$$\text{Expected Value} = 0.15(0.12) + 0.35(0.05) + 0.25(0.02) + 0.14(-0.05) + 0.11(-0.10) = 0.0225 \quad \textbf{13.41}$$

Based on the probability distribution, the expected value of the rate of return for United Airlines common stock over an extended period of time is 2.25%.

| Historical Return (%) | Associated Probability (%) |
|---|---|
| 12 | 15 |
| 5 | 35 |
| 2 | 25 |
| -5 | 14 |
| -10 | 11 |

**Table 13.9 Probability Distribution for Historical Returns on United Airlines Stock**

We can extend this analysis to evaluate the expected return for an investment portfolio consisting of various asset categories, such as stocks, bonds, and cash equivalents, where the probabilities are associated with the weighting of each category relative to the total value of the portfolio. Using historical return data for each of the asset categories, the expected return of the overall portfolio can be calculated using the expected value formula.

Assume an investor has assets in stocks, bonds, and cash equivalents as shown in Table 13.10.

| Asset Category | Value ($) | Portfolio Weighting | Historical Return (%) |
|---|---|---|---|
| Stocks | 306,000 | $\frac{306,000}{600,200} = 0.51$ | 13.0 |
| Bonds | 236,000 | $\frac{236,000}{600,200} = 0.39$ | 4.0 |
| Cash | 58,200 | $\frac{58,200}{600,200} = 0.10$ | 2.5 |
| **Total Value** | **$600,200** | | |

**Table 13.10 Portfolio Weightings and Historical Returns for Various Asset Categories**

$$\text{Expected Value} = P_1 \cdot R_1 + P_2 \cdot R_2 + P_3 \cdot R_3 + \ldots + P_n \cdot R_n \quad \textbf{13.42}$$

$$\text{Expected Value} = 0.51(0.130) + 0.39(0.040) + 0.10(0.025) = 0.0844 \quad \textbf{13.43}$$

Based on the probability distribution, the expected value of the rate of return for this portfolio over an extended period of time is 8.44%.

## Apply the Normal Distribution in Financial Contexts

The normal, or bell-shaped, distribution can be utilized in many applications, including financial contexts. Remember that the normal distribution has two parameters: the mean, which is the center of the distribution, and the standard deviation, which measures the spread of the distribution. Here are several examples of applications of the normal distribution:

- IQ scores follow a normal distribution, with a mean IQ score of 100 and a standard deviation of 15.
- Salaries at a certain company follow a normal distribution, with a mean salary of $52,000 and a standard deviation of $4,800.
- Grade point averages (GPAs) at a certain college follow a normal distribution, with a mean GPA of 3.27 and a standard deviation of 0.24.
- The average annual gain of the Dow Jones Industrial Average (DJIA) over a 40-year time period follows a normal distribution, with a mean gain of 485 points and a standard deviation of 1,065 points.
- The average annual return on the S&P 500 over a 50-year time period follows a normal distribution, with a mean rate of return of 10.5% and a standard deviation of 14.3%.
- The average annual return on mid-cap stock funds over the five-year period from 2010 to 2015 follows a normal distribution, with a mean rate of return of 8.9% and a standard deviation of 3.7%.

When analyzing data sets that follow a normal distribution, probabilities can be calculated by finding areas under the normal curve. To find the probability that a measurement is within a specific interval, we can compute the area under the normal curve corresponding to the interval of interest.

Areas under the normal curve are available in tables, and Excel also provides a method to find these areas. The **empirical rule** is one method for determining areas under the normal curve that fall within a certain number of standard deviations of the mean (see Figure 13.4).

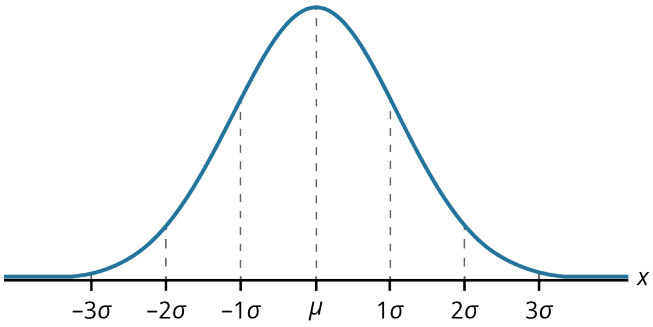



**Figure 13.4 Normal Distribution Showing Mean and Increments of Standard Deviation**

If $x$ is a random variable and has a normal distribution with mean $\mu$ and standard deviation $\sigma$, then the empirical rule states the following:

- About 68% of the $x$-values lie between $-1\sigma$ and $+1\sigma$ units from the mean $\mu$ (within one standard deviation of the mean).
- About 95% of the $x$-values lie between $-2\sigma$ and $+2\sigma$ units from the mean $\mu$ (within two standard deviations of the mean).
- About 99.7% of the $x$-values lie between $-3\sigma$ and $+3\sigma$ units from the mean $\mu$ (within three standard deviations of the mean). Notice that almost all the $x$-values lie within three standard deviations of the mean.
- The $z$-scores for $+1\sigma$ and $-1\sigma$ are $+1$ and $-1$, respectively.
- The $z$-scores for $+2\sigma$ and $-2\sigma$ are $+2$ and $-2$, respectively.
- The $z$-scores for $+3\sigma$ and $-3\sigma$ are $+3$ and $-3$, respectively.

As an example of using the empirical rule, suppose we know that the average annual return for mid-cap stock funds over the five-year period from 2010 to 2015 follows a normal distribution, with a mean rate of return of 8.9% and a standard deviation of 3.7%. We are interested in knowing the likelihood that a randomly selected mid-cap stock fund provides a rate of return that falls within one standard deviation of the mean, which implies a rate of return between 5.2% and 12.6%. Using the empirical rule, the area under the normal curve within one standard deviation of the mean is 68%. Thus, there is a probability, or likelihood, of 0.68 that a mid-cap stock fund will provide a rate of return between 5.2% and 12.6%.

If the interval of interest is extended to two standard deviations from the mean (a rate of return between 1.5% and 16.3%), using the empirical rule, we can determine that the area under the normal curve within two standard deviations of the mean is 95%. Thus, there is a probability, or likelihood, of 0.95 that a mid-cap stock fund will provide a rate of return between 1.5% and 16.3%.

# 13.6 Data Visualization and Graphical Displays

By the end of this section, you will be able to:

- Determine appropriate graphs to use for various types of data.
- Create and interpret univariate graphs such as bar graphs and histograms.
- Create and interpret bivariate graphs such as time series graphs and scatter plot graphs.

## Graphing Univariate Data

**Data visualization** refers to the use of graphical displays to summarize data to help to interpret patterns and trends in the data. *Univariate data* refers to observations recorded for a single characteristic or attribute, such as salaries or blood pressure measurements. When graphing univariate data, we can choose from among several types of graphs, such as bar graphs, time series graphs, and so on.

The most effective type of graph to use for a certain data set will depend on the nature of the data and the purpose of the graph. For example, a time series graph is typically used to show how a measurement is changing over time and to identify patterns or trends over time.

Below are some examples of typical applications for various graphs and displays.

Graphs used to show the distribution of data:

- Bar chart: used to show frequency or relative frequency distributions for categorical data
- Histogram: used to show frequency or relative frequency distributions for continuous data

Graphs used to show relationships between data points:

- Time series graph: used to show measurement data plotted against time, where time is displayed on the horizontal axis
- Scatter plot: used to show the relationship between a dependent variable and an independent variable

### Bar Graphs

A **bar graph** consists of bars that are separated from each other and compare percentages. The bars can be rectangles, or they can be rectangular boxes (used in three-dimensional plots), and they can be vertical or horizontal. The bar graph shown in the example below has age groups represented on the ***x*-axis** and proportions on the ***y*-axis**.

By the end of 2021, a certain social media site had over 146 million users in the United States. Table 13.11 shows three age groups, the number of users in each age group, and the proportion (%) of users in each age group. A bar graph using this data is shown in Figure 13.5.

| Age Groups | Number of Site Users | Percent of Site Users |
|---|---|---|
| 13–25 | 65,082,280 | 45 |
| 26–44 | 53,300,200 | 36 |
| 45–64 | 27,885,100 | 19 |

**Table 13.11 Data for Bar Graph of Age Groups**

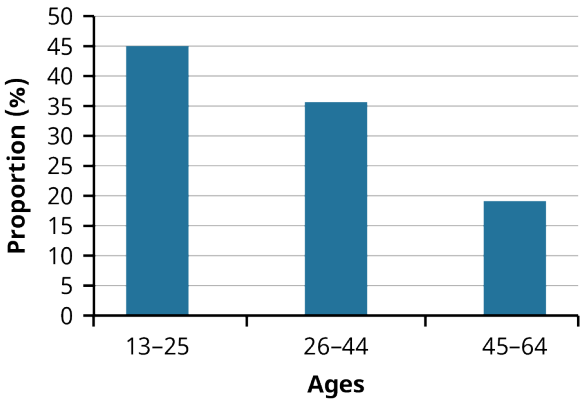



**Figure 13.5 Bar Graph of Age Groups**

## Histograms

A **histogram** is a bar graph that is used for continuous numeric data, such as salaries, blood pressures, heights, and so on. One advantage of a histogram is that it can readily display large data sets. A rule of thumb is to use a histogram when the data set consists of 100 values or more.

A histogram consists of contiguous (adjoining) boxes. It has both a horizontal axis and a vertical axis. The horizontal axis is labeled with what the data represents (for instance, distance from your home to school). The vertical axis is labeled either Frequency or Relative Frequency (or Percent Frequency or Probability). The graph will have the same shape regardless of the label on the vertical axis. A histogram, like a stem-and-leaf plot, can give you the shape of the data, the center, and the spread of the data.

The relative frequency is equal to the frequency of an observed data value divided by the total number of data values in the sample. Remember, frequency is defined as the number of times a solution occurs. Relative frequency is calculated using the formula

$$RF = \frac{f}{n} \quad \textbf{13.44}$$

where $f$ = frequency, $n$ = the total number of data values (or the sum of the individual frequencies), and $RF$ = relative frequency.

To construct a histogram, first decide how many bars or intervals, also called classes, will represent the data. Many histograms consist of 5 to 15 bars or classes for clarity. The number of bars needs to be chosen. Choose a starting point for the first interval that is less than the smallest data value. A convenient starting point is a lower value carried out to one more decimal place than the value with the most decimal places. For example, if the value with the most decimal places is 6.1, and if this is the smallest value, a convenient starting point is 6.05 (because $6.1 - 0.05 = 6.05$). We say that 6.05 has more precision. If the value with the most decimal places is 2.23 and the lowest value is 1.5, a convenient starting point is 1.495 ($1.5 - 0.005 = 1.495$). If the value with the most decimal places is 3.234 and the lowest value is 1.0, a convenient starting point is $0.995$ ($1.0 - 0.0005 = 0.9995$). If all the data values happen to be integers and the smallest value is 2, then a convenient starting point is $1.5$ ($2 - 0.05 = 1.5$). Also, when the starting point and other boundaries are carried to one additional decimal place, no data value will fall on a boundary. The next two examples go into detail about how to construct a histogram using continuous data and how to create a histogram using discrete data.

**Example:** The following data values are the portfolio values, in thousands of dollars, for 100 investors.

60, 60.5, 61, 61, 61.5
63.5, 63.5, 63.5
64, 64, 64, 64, 64, 64, 64, 64.5, 64.5, 64.5, 64.5, 64.5, 64.5, 64.5, 64.5
66, 66, 66, 66, 66, 66, 66, 66, 66, 66, 66.5, 66.5, 66.5, 66.5, 66.5, 66.5, 66.5, 66.5, 66.5, 66.5, 67, 67, 67, 67,

67, 67, 67, 67, 67, 67, 67, 67, 67.5, 67.5, 67.5, 67.5, 67.5, 67.5, 67.5
68, 68, 69, 69, 69, 69, 69, 69, 69, 69, 69, 69.5, 69.5, 69.5, 69.5, 69.5
70, 70, 70, 70, 70, 70, 70.5, 70.5, 70.5, 71, 71, 71
72, 72, 72, 72.5, 72.5, 73, 73.5
74

The smallest data value is 60. Because the data values with the most decimal places have one decimal place (for instance, 61.5), we want our starting point to have two decimal places. Because the numbers 0.5, 0.05, 0.005, and so on are convenient numbers, use 0.05 and subtract it from 60, the smallest value, to get a convenient starting point: $60 - 0.05 = 59.95$, which is more precise than, say, 61.5 by one decimal place. Thus, the starting point is 59.95. The largest value is 74, and $74 + 0.05 = 74.05$, so 74.05 is the ending value.

Next, calculate the width of each bar or class interval. To calculate this width, subtract the starting point from the ending value and divide the result by the number of bars (you must choose the number of bars you desire). Suppose you choose eight bars. The interval width is calculated as follows:

$$\frac{74.05 - 59.95}{8} = 1.76 \quad \textbf{13.45}$$

We will round up to 2 and make each bar or class interval 2 units wide. Rounding up to 2 is one way to prevent a value from falling on a boundary. Rounding to the next number is often necessary, even if it goes against the standard rules of rounding. For this example, using 1.76 as the width would also work. A guideline that is followed by some for the width of a bar or class interval is to take the square root of the number of data values and then round to the nearest whole number if necessary. For example, if there are 150 data values, take the square root of 150 and round to 12 bars or intervals. The boundaries are as follows:

$$\begin{aligned} &59.95 \\ 59.95 &+ 2 = 61.95 \\ 61.95 &+ 2 = 63.95 \\ 63.95 &+ 2 = 65.95 \\ 65.95 &+ 2 = 67.95 \\ 67.95 &+ 2 = 69.95 \\ 69.95 &+ 2 = 71.95 \\ 71.95 &+ 2 = 73.95 \\ 73.95 &+ 2 = 75.95 \end{aligned} \quad \textbf{13.46}$$

The data values 60 through 61.5 are in the interval 59.95–61.95. The data values of 63.5 are in the interval 61.95–63.95. The data values of 64 and 64.5 are in the interval 63.95–65.95. The data values 66 through 67.5 are in the interval 65.95–67.95. The data values 68 through 69.5 are in the interval 67.95–69.95. The data values 70 through 71 are in the interval 69.95–71.95. The data values 72 through 73.5 are in the interval 71.95–73.95. The data value 74 is in the interval 73.95–75.95. The histogram shown in Figure 13.6 displays the portfolio values on the *x*-axis and relative frequency on the *y*-axis.

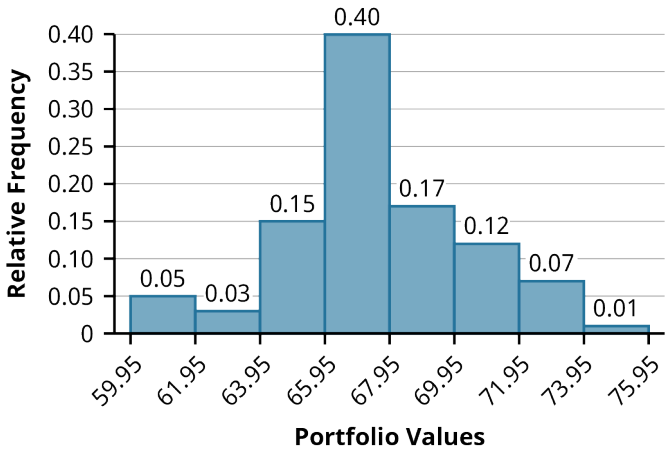



**Figure 13.6 Histogram of Portfolio Values**

## Graphing Bivariate Data

**Bivariate data** refers to paired data, where each value of one variable is paired with a value of a second variable. An example of paired data would be if data were collected on employees' years of experience and their corresponding salaries. Typically, it is of interest to investigate possible associations or correlations between the two variables under analysis.

### Time Series Graphs

Suppose that we want to track the consumer price index (CPI) over the past 10 years. One feature of the data that we may want to consider is the element of time. Because each year is paired with the CPI value for that year, we do not have to think of the data as being random. We can instead use the years given to impose a chronological order on the data. A graph that recognizes this ordering and displays the changing CPI value as the decade progresses is called a time series graph.

To construct a **time series graph**, we must look at both pieces of our paired data set. We start with a standard Cartesian coordinate system. The horizontal axis is used to plot the time increments, and the vertical axis is used to plot the values of the variable that we are measuring. By doing this, we make each point on the graph correspond to a point in time and a measured quantity. The points on the graph are typically connected by straight lines in the order in which they occur.

**Example:** The following data set shows the annual CPI for 10 years. We need to construct a time series graph for the (rounded) annual CPI data (see Table 13.12). The time series graph is shown in Figure 13.7.

| Year | CPI |
|---|---|
| 2012 | 226.65 |
| 2013 | 230.28 |
| 2014 | 233.91 |
| 2015 | 233.70 |
| 2016 | 236.91 |
| 2017 | 242.84 |

**Table 13.12 Data for Time Series Graph of Annual CPI, 2012–2021** (source: US Bureau of Labor Statistics)

| Year | CPI |
|---|---|
| 2018 | 247.87 |
| 2019 | 251.71 |
| 2020 | 257.97 |
| 2021 | 261.58 |

**Table 13.12 Data for Time Series Graph of Annual CPI, 2012–2021** (source: US Bureau of Labor Statistics)

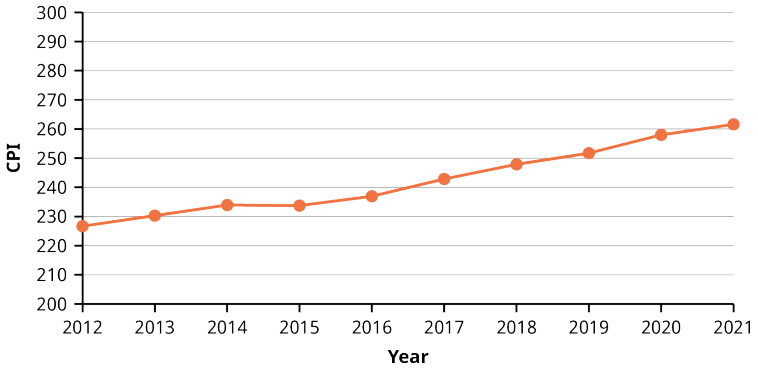



**Figure 13.7 Time Series Graph of Annual CPI, 2012–2021**

## Scatter Plots

A **scatter plot**, or scatter diagram, is a graphical display intended to show the relationship between two variables. The setup of the scatter plot is that one variable is plotted on the horizontal axis and the other variable is plotted on the vertical axis. Then each pair of data values is considered as an (*x*, *y*) point, and the various points are plotted on the diagram. A visual inspection of the plot is then made to detect any patterns or trends. Additional statistical analysis can be conducted to determine if there is a correlation or other statistically significant relationship between the two variables.

Assume we are interested in tracking the closing price of Nike stock over the one-year time period from April 2020 to March 2021. We would also like to know if there is a correlation or relationship between the price of Nike stock and the value of the S&P 500 over the same time period. To visualize this relationship, we can create a scatter plot based on the (*x*, *y*) data shown in Table 13.13. The resulting scatter plot is shown in Figure 13.8.

| Date | S&P 500 | Nike Stock Price ($) |
|---|---|---|
| 4/1/2020 | 2,912.43 | 87.18 |
| 5/1/2020 | 3,044.31 | 98.58 |
| 6/1/2020 | 3,100.29 | 98.05 |
| 7/1/2020 | 3,271.12 | 97.61 |
| 8/1/2020 | 3,500.31 | 111.89 |
| 9/1/2020 | 3,363.00 | 125.54 |

**Table 13.13 Data for S&P 500 and Nike Stock Price over a 12-Month Period** (source: Yahoo! Finance)

| Date | S&P 500 | Nike Stock Price ($) |
|---|---|---|
| 10/1/2020 | 3,269.96 | 120.08 |
| 11/1/2020 | 3,621.63 | 134.70 |
| 12/1/2020 | 3,756.07 | 141.47 |
| 1/1/2021 | 3,714.24 | 133.59 |
| 2/1/2021 | 3,811.15 | 134.78 |
| 3/1/2021 | 3,943.34 | 140.45 |
| 3/12/2021 | 3,943.34 | 140.45 |

**Table 13.13 Data for S&P 500 and Nike Stock Price over a 12-Month Period** (source: Yahoo! Finance)

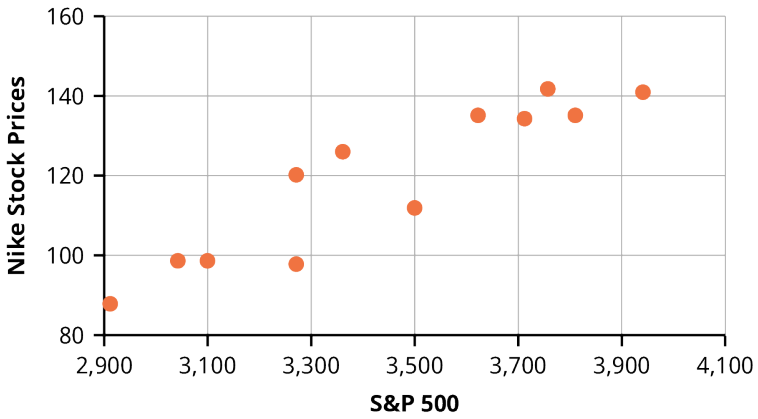



**Figure 13.8 Scatter Plot of Nike Stock Price versus S&P 500**

Note the linear pattern of the points on the scatter plot. Because the data points generally align along a straight line, this provides an indication of a linear correlation between the price of Nike stock and the value of the S&P 500 over this one-year time period.

The scatter plot can be generated using Excel as follows:

1. Enter the *x*-data in column A of a spreadsheet.
2. Enter the *y*-data in column B.
3. Highlight the data with your mouse.
4. Go to the Insert menu and select the icon for a scatter plot, as shown in Figure 13.9.

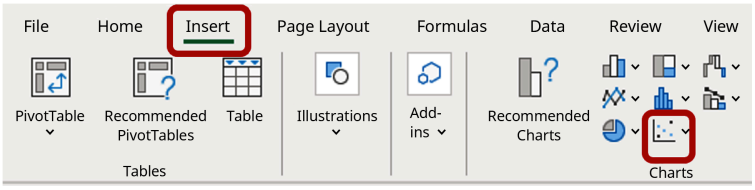



**Figure 13.9 Excel Menu Showing the Scatter Plot Icon**

## 13.7 The R Statistical Analysis Tool

By the end of this section, you will be able to:

- Create a vector of data values for the R statistical analysis tool.
- Write basic statistical commands using the R statistical analysis tool.

## Commands and Vectors in R

R is a statistical analysis tool that is widely used in the finance industry. It is available as a free program and provides an integrated suite of functions for data analysis, graphing, and statistical programming. R is increasingly being used as a data analysis and statistical tool as it is an open-source language and additional features are constantly being added by the user community. The tool can be used on many different computing platforms and can be downloaded at the R Project website (https://openstax.org/r/the-R-project-website).

LINK TO LEARNING

Using the R Statistical Tool

There are many resources for learning and using the R statistical tool, including the following:

How to install R on different computer operating systems (https://openstax.org/r/how-to-install)

Introduction to using R (https://openstax.org/r/introduction-to-using-R)

How to import and export data using R (https://openstax.org/r/how-to-import-and-export)

Frequently asked questions (FAQ) on using R (https://openstax.org/r/frequently-asked-questions)

Once you have installed and started R on your computer, at the bottom of the R console, you should see the symbol >, which indicates that R is ready to accept commands.

```
Type 'demo()' for some demos, 'help()' for on-line help, or 'help.start()' for an HTML
browser interface to help. Type 'q()' to quit R.

>
```

R is a command-driven language, meaning that the user enters commands at the prompt, which R then executes one at a time. R can also execute a program containing multiple commands. There are ways to add a graphic user interface (GUI) to R. An example of a GUI tool for R is RStudio (https://openstax.org/r/RStudio).

The R command line can be used to perform any numeric calculation, similar to a handheld calculator. For example, to evaluate the expression $10 + 3 \cdot 7$, enter the following expression at the command line prompt and hit return:

```
> 10+3*7

[1] 31
```

Most calculations in R are handled via functions. For statistical analysis, there are many preestablished functions in R to calculate mean, median, standard deviation, quartiles, and so on. Variables can be named and assigned values using the assignment operator <-. For example, the following R commands assign the value of 20 to the variable named *x* and assign the value of 30 to the variable named *y*:

```
> x <- 20

> y <- 30
```

These variable names can be used in any calculation, such as multiplying *x* by *y* to produce the result 600:

```
> x*y

[1] 600
```

The typical method for using functions in statistical applications is to first create a vector of data values. There are several ways to create vectors in R. For example, the *c* function is often used to combine values into a vector. The following R command will generate a vector called *salaries* that contains the data values 40,000, 50,000, 75,000, and 92,000:

```
> salaries <- c(40000, 50000, 75000, 92000)
```

This vector *salaries* can then be used in statistical functions such as mean, median, min, max, and so on, as shown:

```
> mean(salaries)

[1] 64250

> median(salaries)

[1] 62500

> min(salaries)

[1] 40000

> max(salaries)

[1] 92000
```

Another option for generating a vector in R is to use the *seq* function, which will automatically generate a sequence of numbers. For example, we can generate a sequence of numbers from 1 to 5, incremented by 0.5, and call this vector *example1*, as follows:

```
> example1 <- seq(1, 5, by=0.5)
```

If we then type the name of the vector and hit enter, R will provide a listing of numeric values for that vector name.

```
> salaries

[1] 40000 50000 75000 92000

> example1
```

```
[1] 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
```

Often, we are interested in generating a quick statistical summary of a data set in the form of its mean, median, quartiles, min, and max. The R command called *summary* provides these results.

```
> summary(salaries)

Min. 1st Qu. Median Mean 3rd Qu. Max.

40000 47500 62500 64250 79250 92000
```

For measures of spread, R includes a command for standard deviation, called *sd*, and a command for variance, called *var*. The standard deviation and variance are calculated with the assumption that the data set was collected from a sample.

```
> sd(salaries)

[1] 23641.42

> var(salaries)

[1] 558916667
```

To calculate a weighted mean in R, create two vectors, one of which contains the data values and the other of which contains the associated weights. Then enter the R command *weighted.mean(values, weights)*.

The following is an example of a weighted mean calculation in R:
Assume your portfolio contains 1,000 shares of XYZ Corporation, purchased on three different dates, as shown in Table 13.14. Calculate the weighted mean of the purchase price, where the weights are based on the number of shares in the portfolio.

| Date Purchased | Purchase Price ($) | Number of Shares Purchased |
|---|---|---|
| January 17 | 78 | 200 |
| February 10 | 122 | 300 |
| March 23 | 131 | 500 |
| **Total** | | **1,000** |

**Table 13.14 Portfolio of XYZ Shares**

Here is how you would create two vectors in R: the *price* vector will contain the purchase price, and the *shares* vector will contain the number of shares. Then execute the R command *weighted.mean(price, shares)*, as follows:

```
> price <- c(78, 122, 131)

> shares <- c(200, 300, 500)
```

```
> weighted.mean(price, shares)

[1] 117.7
```

A list of common R statistical commands appears in Table 13.15.

| R Command | Result |
|---|---|
| mean( ) | Calculates the arithmetic mean |
| median( ) | Calculates the median |
| min( ) | Calculates the minimum value |
| max( ) | Calculates the maximum value |
| weighted.mean( ) | Calculates the weighted mean |
| sum( ) | Calculates the sum of values |
| summary( ) | Calculates the mean, median, quartiles, min, and max |
| sd( ) | Calculates the sample standard deviation |
| var( ) | Calculates the sample variance |
| IQR( ) | Calculates the interquartile range |
| barplot( ) | Plots a bar chart of non-numeric data |
| boxplot( ) | Plots a boxplot of numeric data |
| hist( ) | Plots a histogram of numeric data |
| plot( ) | Plots various graphs, including a scatter plot |
| freq( ) | Creates a frequency distribution table |

**Table 13.15 List of Common R Statistical Commands**

## Graphing in R

There are many statistical applications in R, and many graphical representations are possible, such as bar graphs, histograms, time series plots, scatter plots, and others. The basic command to create a plot in R is the plot command, *plot(x, y)*, where *x* is a vector containing the *x*-values of the data set and *y* is a vector containing the *y*-values of the data set.

The general format of the command is as follows:

```
>plot(x, y, main="text for title of graph", xlab="text for x-axis label", ylab="text for y-axis label")
```

For example, we are interested in creating a scatter plot to examine the correlation between the value of the S&P 500 and Nike stock prices. Assume we have the data shown in Table 13.13, collected over a one-year time period.

Note that data can be read into R from a text file or Excel file or from the clipboard by using various R commands. Assume the values of the S&P 500 have been loaded into the vector *SP500* and the values of Nike stock prices have been loaded into the vector *Nike*. Then, to generate the scatter plot, we can use the following R command:

```
>plot(SP500, Nike, main="Scatter Plot of Nike Stock Price vs. S&P 500", xlab="S&P
```

```
500", ylab="Nike Stock Price")
```

As a result of these commands, R provides the scatter plot shown in Figure 13.10. This is the same data that was used to generate the scatter plot in Figure 13.8 in Excel.

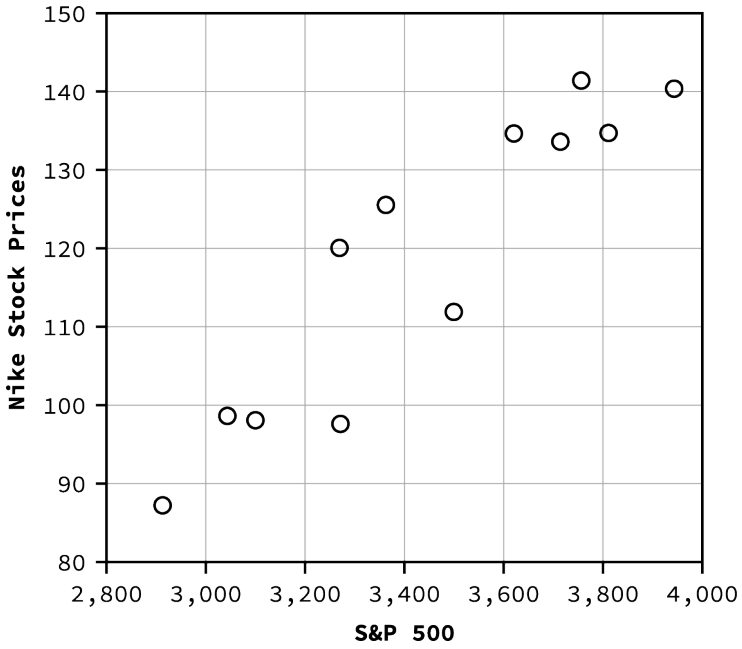



**Figure 13.10 Scatter Plot Generated by R for Nike Stock Price versus S&P 500**

# Summary

## 13.1 Measures of Center

Several measurements are used to provide the average of a data set, including mean, median, and mode. The terms *mean* and *average* are often used interchangeably. To calculate the mean for a set of numbers, add the numbers together and then divide the sum by the number of data values. The geometric mean redistributes not the sum of the values but the product by multiplying all of the individual values and then redistributing them in equal portions such that the total product remains the same. To calculate the median for a set of numbers, order the data from smallest to largest and identify the middle data value in the ordered data set.

## 13.2 Measures of Spread

The standard deviation and variance are measures of the spread of a data set. The standard deviation is small when the data values are all concentrated close to the mean, exhibiting little variation or spread. The standard deviation is larger when the data values are more spread out from the mean, exhibiting more variation. The formula used to calculate the standard deviation depends on whether the data represents a sample or a population, as the formulas for the sample standard deviation and the population standard deviation are slightly different.

## 13.3 Measures of Position

Several measures are used to indicate the position of a data value in a data set. One measure of position is the *z*-score for a particular measurement. The *z*-score indicates how many standard deviations a particular measurement is above or below the mean. Other measures of position include quartiles and percentiles. Quartiles are special percentiles. The first quartile, $Q_1$, is the same as the 25th percentile, and the third quartile, $Q_3$, is the same as the 75th percentile. The median, $M$, is called both the second quartile and the 50th percentile. To calculate quartiles and percentiles, the data must be ordered from smallest to largest. Quartiles divide ordered data into quarters. Percentiles divide ordered data into hundredths.

## 13.4 Statistical Distributions

A frequency distribution provides a method of organizing and summarizing a data set and allows us to organize and tabulate the data in a summarized way. Once a frequency distribution is generated, it can be used to create graphs to help facilitate an interpretation of the data set. The normal distribution has two parameters, or numerical descriptive measures: the mean, $\mu$, and the standard deviation, $\sigma$. The exponential distribution is often concerned with the amount of time until some specific event occurs.

## 13.5 Probability Distributions

A probability distribution is a mathematical function that assigns probabilities to various outcomes. In many financial situations, we are interested in determining the expected value of the return on a particular investment or the expected return on a portfolio of multiple investments. When analyzing distributions that follow a normal distribution, probabilities can be calculated by finding the area under the graph of the normal curve.

## 13.6 Data Visualization and Graphical Displays

*Data visualization* refers to the use of graphical displays to summarize a data set to help to interpret patterns and trends in the data. *Univariate data* refers to observations recorded for a single characteristic or attribute, such as salaries or blood pressure measurements. When graphing univariate data, we can choose from among several types of graphs. The type of graph to be used for a certain data set will depend on the nature of the data and the purpose of the graph. Examples of graphs for univariate data include line graphs, bar graphs, and histograms. *Bivariate data* refers to paired data where each value of one variable is paired with a value of a second variable. Examples of graphs for bivariate data include time series graphs and scatter plots.

## 13.7 The R Statistical Analysis Tool

R is an open-source statistical analysis tool that is widely used in the finance industry. It provides an integrated suite of functions for data analysis, graphing, and statistical programming. R is increasingly being used as a data analysis and statistical tool as it is an open-source language, and additional features are constantly being added by the user community. This tool can be used on many different computing platforms and can be downloaded at The R Project for Statistical Computing (https://openstax.org/r/The-R-Project).

## Key Terms

**arithmetic mean** a measure of center of a data set, calculated by adding up the data values and dividing the sum by the number of data values

**bar graph** a chart that presents categorical data in a summarized form based on frequency or relative frequency

**bivariate data** paired data in which each value of one variable is paired with a value of a second variable

**data visualization** the use of graphical displays, such as bar charts, histograms, and scatter plots, to help interpret patterns and trends in a data set

**empirical rule** a rule that provides the percentages of data values falling within one, two, and three standard deviations from the mean for a bell-shaped (normal) distribution

**expected value** a weighted average of the values of a variable where the weights are the associated probabilities

**exponential distribution** a continuous probability distribution that is useful for calculating probabilities within the time between events

**frequency distribution** a method of organizing and summarizing a data set that provides the frequency with which each value in the data set occurs

**geometric mean** a measure of center of a data set, calculated by multiplying the data values and then raising the product to the exponent $\frac{1}{n}$, where $n$ is the number of data values

**histogram** a graphical display of continuous data showing class intervals on the horizontal axis and frequency or relative frequency on the vertical axis

**interquartile range (IQR)** a number that indicates the spread of the middle half, or middle 50%, of the data; the difference between the third quartile ($Q_3$) and the first quartile ($Q_1$)

**median** the middle value in an ordered data set

**mode** the most frequently occurring data value in a data set

**normal distribution** a bell-shaped distribution curve that is used to model many measurements, including IQ scores, salaries, heights, weights, blood pressures, etc.

**outliers** data values that are significantly different from the other data values in a data set

**percentiles** numbers that divide an ordered data set into hundredths; often used to indicate position of a data value in a data set

**population data** data representing all the outcomes or measurements that are of interest

**portfolio** a collection of financial investments, such as stocks, bonds, mutual funds, certificates of deposit, etc.

**probability distribution** a mathematical function that assigns probabilities to various outcomes

**quartiles** numbers that divide an ordered data set into quarters; the second quartile is the same as the median

**sample data** data representing outcomes or measurements collected from a subset or part of a population

**scatter plot (or scatter diagram)** a graphical display that shows the relationship between a dependent variable and an independent variable

**standard deviation** a measure of the spread of a data set that indicates how far a typical data value is from the mean

**time series graph** a graphical display used to show measurement data plotted versus time, where time is displayed on the horizontal axis

**variance** the measure of the spread of data values calculated as the square of the standard deviation
**weighted mean** a measure of center of a data set in which each data value has a corresponding weighting
***x*-axis** the horizontal axis in a rectangular coordinate system
***y*-axis** the vertical axis in a rectangular coordinate system
***z*-score (or *z*-value)** a measure of the position of a data value in the data set, calculated by subtracting the mean from the data value and then dividing the difference by the standard deviation

## CFA Institute

This chapter supports some of the Learning Outcome Statements (LOS) in this CFA® Level I Study Session (https://openstax.org/r/cfa-level1-study-session). Reference with permission of CFA Institute.

## Multiple Choice

1. A data set of salaries contains an outlier salary. The best measure of center to use for this data set is the _____.
   **a.** mean
   **b.** median
   **c.** mode
   **d.** standard deviation

2. A portfolio includes shares of United Airlines stock that were purchased at different times and different prices. Which measure is best to determine the average cost of the shares of the stock?
   **a.** mean
   **b.** median
   **c.** weighted mean
   **d.** standard deviation

3. Standard deviation is a measure of the _____.
   **a.** center of a data set
   **b.** position of a data value in a data set
   **c.** area under a normal curve
   **d.** spread of a distribution

4. How are standard deviation and variance related?
   **a.** The two measures are equal to one another.
   **b.** Variance is the square root of the standard deviation.
   **c.** Standard deviation is the square root of the variance.
   **d.** The two squared measures are equal to one another.

5. Which of the following is the best definition of a *z*-score?
   **a.** the distance of a data value from the mean
   **b.** the number of standard deviations that a data value is from the mean
   **c.** the distance of a data value from the mean divided by the sample size
   **d.** the number of quartiles that a data value is from the mean

6. The results of a standardized test indicate that you are in the 85th percentile. What is the best interpretation of this result?
   **a.** You scored in the top 85% of all students taking the test.
   **b.** You scored in the top 15% of all students taking the test.
   **c.** Your score on the test is 85 when measured on a scale from 0 to 100.
   **d.** You scored in the bottom 15% of all students taking the test.

7. The interquartile range is _____.

**a.** the middle 50% of a data set
**b.** the upper 50% of a data set
**c.** the lower 50% of a data set
**d.** equal to the median

**8.** In a frequency distribution table, the sum of the relative frequencies must be equal to _____.
**a.** the sample size
**b.** 1, or 100%
**c.** zero
**d.** the standard deviation of the distribution

**9.** A change in the standard deviation of a normal distribution will result in _____.
**a.** a change in the location of the peak of the curve
**b.** a change in the area under the curve
**c.** a change in the shape of the curve
**d.** a change that shifts the graph to the left or the right

**10.** When calculating an expected value, _____.
**a.** the result should always be 1
**b.** the result should always be a positive value
**c.** the result should always be a negative value
**d.** the result can be a positive or negative value

**11.** The area under a normal curve between a *z*-score of -2 and a *z*-score of +2 is _____.
**a.** 0.68
**b.** 0.95
**c.** 0.997
**d.** dependent on the mean and standard deviation

**12.** A scatter plot is a visualization for _____.
**a.** univariate data only
**b.** bivariate data only
**c.** either univariate or bivariate data
**d.** test scores

**13.** Which of the following is NOT a benefit of using the R statistical analysis tool?
**a.** Additional features are constantly being added by the user community.
**b.** It can be used on many computer platforms, including Mac, Windows, and Linux.
**c.** It is free to download.
**d.** Users pay an annual subscription fee.

## Review Questions

**1.** Explain the considerations that determine whether the mean or the median is the best measure of central tendency for a data set.

**2.** Explain the difference between a mean and a weighted mean.

**3.** Explain why the standard deviation of a data set cannot be a negative value.

**4.** Explain what a negative *z*-score, a positive *z*-score, and a *z*-score of zero imply.

**5.** Explain how quartiles can be used to detect outliers in a data set.

# Problems

1. You purchased 1,000 shares of a stock for $12 per share. Then, two months later, you purchased an additional 500 shares of the same stock at $9 per share. Calculate the weighted mean of the purchase price for the total of 1,500 shares.
2. You score a 60 on a biology test. The mean test grade is 70, and the standard deviation is 5. Calculate and interpret your corresponding *z*-score.
3. You score a 60 on a biology test. The mean test grade is 70, and the standard deviation is 5. What percentile does your grade correspond to?
4. A fast food restaurant has measured service time for customers waiting in line, and the service time follows an exponential distribution with a mean waiting time of 1.9 minutes. The restaurant has a guarantee that if customers wait in line for more than 5 minutes, their meal is free. What is the probability that a customer will receive a free meal?
5. The total value of your portfolio consists of approximately 65% stock assets, 25% bonds, and 10% cash equivalents. Historical returns have shown that stocks provide a return of 12%, bonds provide a return of 3.5%, and cash savings provide a return of 1.5%. What is the expected value of the return on this portfolio?
6. The distribution of the average annual return of the S&P 500 over a 50-year time period follows a normal distribution with a mean rate of return of 10.5% and a standard deviation of 14.3%. What is the probability that an average annual return will fall between -3.8% and 24.8%?
7. Write a short R program to find the expected return for the data set in the table below.

| Historical Return on United Airlines Stock | Associated Probability |
|---|---|
| 12% | 15% |
| 5% | 35% |
| 2% | 25% |
| -5% | 14% |
| -10% | 11% |

**Table 13.16**

# Video Activity

## Normal Distribution Stock Return Calculations

Access multimedia content (http://openstax.org/books/principles-finance/pages/13-video-activity)

1. Assume the return on stocks follows a normal distribution. Is it more likely that a stock will return between -1 and +1 standard deviations from the mean or between -2 and +2 standard deviations from the mean? Why?
2. Would an investor be likely to prefer a stock that has a smaller standard deviation for annual stock returns or one with a larger standard deviation for annual stock returns? Why?

## Portfolio Weights

Access multimedia content (http://openstax.org/books/principles-finance/pages/13-video-activity)

3. What are the reasons for calculating portfolio weights? What useful information does this provide to the investor?
4. What are the advantages and disadvantages of the equal weighting approach and the market cap

weighting approach for portfolio allocation strategy?

14

# Regression Analysis in Finance

**Figure 14.1** Regression analysis is used in financial decision-making. (credit: modification of "Stock exchange" by Jack Sem/flickr, CC BY 2.0)

## Chapter Outline


**14.1** Correlation Analysis
**14.2** Linear Regression Analysis
**14.3** Best-Fit Linear Model
**14.4** Regression Applications in Finance
**14.5** Predictions and Prediction Intervals
**14.6** Use of R Statistical Analysis Tool for Regression Analysis


## Why It Matters

Correlation and regression analysis are used extensively in finance applications. Correlation analysis allows the determination of a statistical relationship between two numeric quantities. Regression analysis can be used to predict one quantity based on a second quantity, assuming there is a significant correlation between the two quantities. For example, in finance, we use regression analysis to calculate the beta coefficient of a stock, which represents the volatility of the stock versus overall market volatility, with volatility being a measure of risk.

A business may want to establish a correlation between the amount the company spent on advertising versus its recorded sales. If a strong enough correlation is established, then the business manager can predict sales based on the amount spent on advertising for a given time period.

Finance professionals often use correlation analysis to predict future trends and mitigate risk in a stock portfolio. For example, if two investments are strongly correlated, an investor might not want to have both investments in a certain portfolio since the two investments would tend to move in the same directions during up markets or down markets. To diversify a portfolio, an investor might seek investments that are not strongly correlated with one another.

Regression analysis can be used to establish a mathematical equation that relates a dependent variable (such as sales) to an independent variable (such as advertising expenditure). In this discussion, the focus will be on

analyzing the relationship between one dependent variable and one independent variable, where the relationship can be modeled using a linear equation. This type of analysis is called *linear regression*.

# 14.1 Correlation Analysis

## Learning Outcomes

By the end of this section, you will be able to:

- Calculate a correlation coefficient.
- Interpret a correlation coefficient.
- Test for the significance of a correlation coefficient.

## Calculate a Correlation Coefficient

In correlation analysis, we study the relationship between bivariate data, which is data collected on two variables where the data values are paired with one another.

**Correlation** is the measure of association between two numeric variables. For example, we may be interested to know if there is a correlation between bond prices and interest rates or between the age of a car and the value of the car. To investigate the correlation between two numeric quantities, the first step is to create a scatter plot that will graph the (*x, y*) ordered pairs. The independent, or explanatory, quantity is labeled as the *x*-variable, and the dependent, or response, quantity is labeled as the *y*-variable.

For example, we may be interested to know if the price of Nike stock is correlated with the value of the S&P 500 (Standard & Poor's 500 stock market index). To investigate this, monthly data can be collected for Nike stock prices and value of the S&P 500 for a period of time, and a scatter plot can be created and examined. A **scatter plot**, or **scatter diagram**, is a graphical display intended to show the relationship between two variables. The setup of the scatter plot is that one variable is plotted on the horizontal axis and the other variable is plotted on the vertical axis. Each pair of data values is considered as an (*x, y*) point, and the various points are plotted on the diagram. A visual inspection of the plot is then made to detect any patterns or trends on the scatter diagram. Table 14.1 shows the relationship between the Nike stock price and its S&P value over a one-year time period.

To assess linear correlation, the graphical trend of the data points is examined on the scatter plot to determine if a straight-line pattern exists. If a linear pattern exists, the correlation may indicate either a positive or a negative correlation. A positive correlation indicates that as the independent variable increases, the dependent variable tends to increase as well, or, as the independent variable decreases, the dependent variable tends to decrease (the two quantities move in the same direction). A negative correlation indicates that as the independent variable increases, the dependent variable decreases, or, as the independent variable decreases, the dependent variable increases (the two quantities move in opposite directions). If there is no relationship or association between the two quantities, where one quantity changing does not affect the other quantity, we conclude that there is no correlation between the two variables.

| Date | S&P 500 | Nike Stock Price |
|---|---|---|
| 4/1/2020 | 2,912.43 | 87.18 |
| 5/1/2020 | 3,044.31 | 98.58 |
| 6/1/2020 | 3,100.29 | 98.05 |
| 7/1/2020 | 3,271.12 | 97.61 |

**Table 14.1 Nike Stock Price ($) and Value of S&P 500 over a One-Year Time Period** (source: Yahoo! Finance)

| Date | S&P 500 | Nike Stock Price |
|---|---|---|
| 8/1/2020 | 3,500.31 | 111.89 |
| 9/1/2020 | 3,363.00 | 125.54 |
| 10/1/2020 | 3,269.96 | 120.08 |
| 11/1/2020 | 3,621.63 | 134.70 |
| 12/1/2020 | 3,756.07 | 141.47 |
| 1/1/2021 | 3,714.24 | 133.59 |
| 2/1/2021 | 3,811.15 | 134.78 |
| 3/1/2021 | 3,943.34 | 140.45 |
| 3/12/2021 | 3,943.34 | 140.45 |

**Table 14.1 Nike Stock Price ($) and Value of S&P 500 over a One-Year Time Period** (source: Yahoo! Finance)

From the scatter plot in the Nike stock versus S&P 500 example (see Figure 14.2), we note that the trend reflects a positive correlation in that as the value of the S&P 500 increases, the price of Nike stock tends to increase as well.

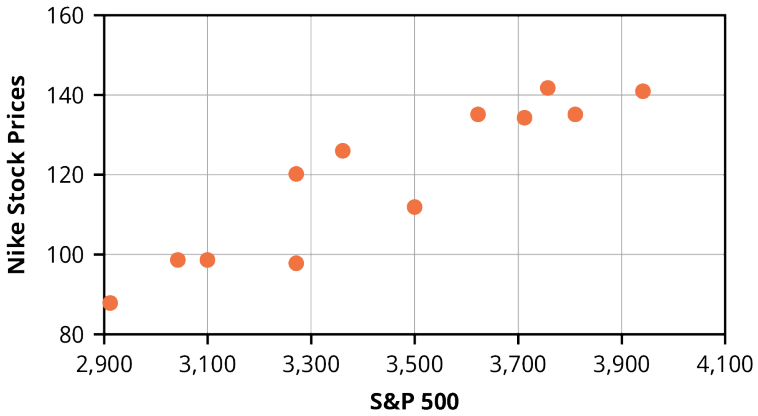



**Figure 14.2 Scatter Plot of Nike Stock Price ($) and Value of S&P 500** (data source: Yahoo! Finance)

When inspecting a scatter plot, it may be difficult to assess a correlation based on a visual inspection of the graph alone. A more precise assessment of the correlation between the two quantities can be obtained by calculating the numeric correlation coefficient (referred to using the symbol $r$).

The **correlation coefficient**, which was developed by statistician Karl Pearson in the early 1900s, is a measure of the strength and direction of the correlation between the independent variable $x$ and the dependent variable $y$.

The formula for $r$ is shown below; however, technology, such as Excel or the statistical analysis program R, is typically used to calculate the correlation coefficient.

$$r = \frac{n\sum \text{xy} - \left(\sum x\right)\left(\sum y\right)}{\sqrt{n\sum x^2 - \left(\sum x\right)^2}\sqrt{n\sum y^2 - \left(\sum y\right)^2}} \quad \textbf{14.1}$$

where $n$ refers to the number of data pairs and the symbol $\sum x$ indicates to sum the $x$-values.

Table 14.2 provides a step-by-step procedure on how to calculate the correlation coefficient *r*.

| Step | Representation in Symbols |
|---|---|
| 1. Calculate the sum of the *x*-values. | $\sum x$ |
| 2. Calculate the sum of the *y*-values. | $\sum y$ |
| 3. Multiply each *x*-value by the corresponding *y*-value and calculate the sum of these *xy* products. | $\sum xy$ |
| 4. Square each *x*-value and then calculate the sum of these squared values. | $\sum x^2$ |
| 5. Square each *y*-value and then calculate the sum of these squared values. | $\sum y^2$ |
| 6. Determine the value of *n,* which is the number of data pairs. | $n$ |
| 7. Use these results to then substitute into the formula for the correlation coefficient. | $r = \frac{n\sum \text{xy} - (\sum x)(\sum y)}{\sqrt{n\sum x^2 - (\sum x)^2}\sqrt{n\sum y^2 - (\sum y)^2}}$ |

**Table 14.2 Steps for Calculating the Correlation Coefficient**

Note that since *r* is calculated using sample data, *r* is considered a sample statistic used to measure the strength of the correlation for the two population variables. Sample data indicates data based on a subset of the entire population.

Given the complexity of this calculation, Excel or other software is typically used to calculate the correlation coefficient.

The Excel command to calculate the correlation coefficient uses the following format:

```
=CORREL(A1:A10, B1:B10)
```

where A1:A10 are the cells containing the *x*-values and B1:B10 are the cells containing the *y*-values.

*Download the spreadsheet file (https://openstax.org/r/excel_exhibits) containing key Chapter 14 Excel exhibits.*

## Interpret a Correlation Coefficient

Once the value of *r* is calculated, this measurement provides two indicators for the correlation:

a. the strength of the correlation based on the *value* of *r*
b. the direction of the correlation based on the *sign* of *r*

The *value* of *r* gives us this information:

- The value of *r* is always between $-1$ and $+1$: $-1 \leq r \leq 1$.
- The size of the correlation *r* indicates the strength of the linear relationship between the two variables. Values of *r* close to $-1$ or to $+1$ indicate a stronger linear relationship.
- If $r = 0$, there is no linear relationship between the two variables (no **linear correlation**).
- If $r = 1$, there is perfect positive correlation.
- If $r = -1$, there is perfect negative correlation. In both of these cases, all the original data points lie on a straight line.

The *sign* of *r* gives us this information:

- A positive value of *r* means that when *x* increases, *y* tends to increase, and when *x* decreases, *y* tends to

decrease (*positive correlation*).

- A negative value of $r$ means that when $x$ increases, $y$ tends to decrease, and when $x$ decreases, $y$ tends to increase (*negative correlation*).

## LINK TO LEARNING

### Correlation in Finance Applications

This video on correlation concepts (https://openstax.org/r/video_correlation) discusses them with a specific focus on finance applications.

The Excel command used to find the value of the correlation coefficient for the Nike stock versus S&P 500 example (refer back to Table 14.1) is

```
=CORREL(B2:B14,C2:C14)
```

In this example, the value of $r$ is calculated by Excel to be $r = 0.928$.

Since this is a positive value close to 1, we conclude that the relationship between Nike stock and the value of the S&P 500 over this time period represents a strong, positive correlation.

The correlation coefficient $r$ can also be determined using the statistical capability on the financial calculator:

- Step 1 is to enter the data in the calculator (using the [DATA] function that is located above the 7 key).
- Step 2 is to access the statistical results provided by the calculator (using the [STAT] function that is located above the 8 key) and scroll to the correlation coefficient results.

Follow the steps in Table 14.3 for calculating the correlation data for the data set of Nike stock price and value of the S&P 500 shown previously.

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 1 | Enter [DATA] entry mode | 2ND [DATA] | X01 | 0.00 |
| 2 | Clear any previous data | 2ND [CLR WORK] | X01 | 0.00 |
| 3 | Enter first $x$-value of 2912.43 | 2912.43 ENTER | X01 = | 2,912.43 |
| 4 | Move to next data entry | ↓ | Y01 = | 1.00 |
| 5 | Enter first $y$-value of 87.18 | 87.18 ENTER | Y01 = | 87.18 |
| 6 | Move to next data entry | ↓ | X02 | 0.00 |
| 7 | Enter second $x$-value of 3044.31 | 3044.31 ENTER | X02 = | 3,044.31 |
| 8 | Move to next data entry | ↓ | Y02 = | 1.00 |
| 9 | Enter second $y$-value of 98.58 | 98.58 ENTER | Y02 = | 98.58 |
| 10 | Move to next data entry | ↓ | X03 | 0.00 |
| 11 | Continue to enter remaining data values | | | |
| 12 | Enter [STAT] mode | 2ND [STAT] | | |
| 13 | Press [SET] until LIN appears | 2ND [SET] | LIN | |

**Table 14.3 Calculator Steps for Finding the Relationship between Nike Stock Price and Value of S&P 500**[1]

1 The specific financial calculator in these examples is the Texas Instruments BA II Plus ™ Professional model, but you can use other financial calculators for these types of calculations.

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 14 | Move to 1st statistical result | ↓ | $n =$ | 13.00 |
| 15 | Move to next statistical result | ↓ | $\overline{x} =$ | 3,480.86 |
| 16 | Continue to scroll down until the value of *r* is displayed | ↓ | $r =$ | 0.93 |

**Table 14.3 Calculator Steps for Finding the Relationship between Nike Stock Price and Value of S&P 500**[1]

From the statistical results shown on the calculator display, the correlation coefficient *r* is 0.93, which indicates that the relationship between Nike stock and the value of the S&P 500 over this time period represents a strong, positive correlation.

Note: A strong correlation does not suggest that *x* causes *y* or *y* causes *x*. We must remember that *correlation does not imply causation.*

## Test a Correlation Coefficient for Significance

The correlation coefficient, *r*, tells us about the strength and direction of the linear relationship between *x* and *y*. The sample data are used to compute *r*, the correlation coefficient for the sample. If we had data for the entire population (that is, all measurements of interest), we could find the population correlation coefficient, which is labeled as the Greek letter $\rho$ (pronounced "rho"). But because we have only sample data, we cannot calculate the population correlation coefficient. The sample correlation coefficient, *r*, is our estimate of the unknown population correlation coefficient.

- $\rho$ = population correlation coefficient (unknown)
- *r* = sample correlation coefficient (known; calculated from sample data)

An important step in the correlation analysis is to determine if the correlation is significant. By this, we are asking if the correlation is strong enough to allow meaningful predictions for *y* based on values of *x*. One method to test the significance of the correlation is to employ a hypothesis test. The hypothesis test lets us decide whether the value of the population correlation coefficient $\rho$ is close to zero or significantly different from zero. We decide this based on the sample correlation coefficient *r* and the sample size *n*.

If the test concludes that the correlation coefficient is significantly different from zero, we say that the correlation coefficient is significant.

- Conclusion: There is sufficient evidence to conclude that there is a significant linear relationship between *x* and *y* variables because the correlation coefficient is significantly different from zero.
- What the conclusion means: There is a significant linear relationship between the *x* and *y* variables. If the test concludes that the correlation coefficient is not significantly different from zero (it is close to zero), we say that the correlation coefficient is not significant.

A hypothesis test can be performed to test if the correlation is significant. A hypothesis test is a statistical method that uses sample data to test a claim regarding the value of a population parameter. In this case, the hypothesis test will be used to test the claim that the population correlation coefficient $\rho$ is equal to zero.

Use these hypotheses when performing the hypothesis test:

- Null hypothesis: $H_0: \rho = 0$
- Alternate hypothesis: $H_a: \rho \neq 0$

The hypotheses can be stated in words as follows:

- Null hypothesis $H_0$: The population correlation coefficient *is not* significantly different from zero. There *is not* a significant linear relationship (correlation) between *x* and *y* in the population.
- Alternate hypothesis $H_a$: The population correlation coefficient is significantly different from zero. There *is*

a significant linear relationship (correlation) between *x* and *y* in the population.

A quick shorthand way to test correlations is the relationship between the sample size and the correlation. If $|r| \geq \frac{2}{\sqrt{n}}$, then this implies that the correlation between the two variables demonstrates that a linear relationship exists and is statistically significant at approximately the 0.05 level of significance. As the formula indicates, there is an inverse relationship between the sample size and the required correlation for significance of a linear relationship. With only 10 observations, the required correlation for significance is 0.6325; for 30 observations, the required correlation for significance decreases to 0.3651; and at 100 observations, the required level is only 0.2000.

NOTE:

- If *r* is significant and the scatter plot shows a linear trend, the line can be used to predict the value of *y* for values of *x* that are within the domain of observed *x*-values.
- If *r* is not significant OR if the scatter plot does not show a linear trend, the line should not be used for prediction.
- If *r* is significant and the scatter plot shows a linear trend, the line may *not* be appropriate or reliable for prediction *outside* the domain of observed *x*-values in the data.

## THINK IT THROUGH

### Determining If a Correlation Is Significant

Suppose that the chief financial officer (CFO) of a corporation is investigating the correlation between stock prices and unemployment rate over a period of 10 years and finds the correlation coefficient to be -0.68. There are 10 (*x, y*) data points in the data set. Should the CFO conclude that the correlation is significant for the relationship between stock prices and unemployment rate based on a level of significance of 0.05?

**Solution:**

When using a level of significance of 0.05, if $|r| \geq \frac{2}{\sqrt{n}}$, then this implies that the correlation between the two variables demonstrates a linear relationship that is statistically significant at approximately the 0.05 level of significance. In this example, we check if $|-0.68|$ is greater than or equal to $\frac{2}{\sqrt{n}}$ where $n = 10$. Since $\frac{2}{\sqrt{10}}$ is approximately 0.632, this indicates that the absolute value of *r* of $-0.68$ is greater than $\frac{2}{\sqrt{n}}$, and thus the correlation is deemed as significant.

Correlations may be helpful in visualizing the data, but they are not appropriately used to explain a relationship between two variables. Perhaps no single statistic is more misused than the correlation coefficient. Citing correlations between health conditions and everything from place of residence to eye color have the effect of implying a cause-and-effect relationship. This simply cannot be accomplished with a correlation coefficient. The correlation coefficient is, of course, innocent of this misinterpretation. It is the duty of analysts to use a statistic that is designed to test for cause-and-effect relationships and to report only those results, if they are intending to make such a claim. The problem is that passing this more rigorous test is difficult, therefore lazy and/or unscrupulous researchers fall back on correlations when they cannot make their case legitimately.

# 14.2 Linear Regression Analysis

## Learning Outcomes

By the end of this section, you will be able to:

- Analyze a regression using the method of least squares and residuals.
- Test the assumptions for linear regression.

## Method of Least Squares and Residuals

Once the correlation coefficient has been calculated and a determination has been made that the correlation is significant, typically a regression model is then developed. In this discussion we will focus on linear regression, where a straight line is used to model the relationship between the two variables. Once a straight-line model is developed, this model can then be used to predict the value of the dependent variable for a specific value of the independent variable.

Recall from algebra that the equation of a straight line is given by

$$y = mx + b \tag{14.2}$$

where $m$ is the slope of the line and $b$ is the $y$-intercept of the line.

The slope measures the steepness of the line, and the $y$-intercept is that point on the $y$-axis where the graph crosses, or intercepts, the $y$-axis.

In linear regression analysis, the equation of the straight line is written in a slightly different way using the model

$$\hat{y} = a + bx \tag{14.3}$$

In this format, $b$ is the slope of the line, and $a$ is the $y$-intercept. The notation $\hat{y}$ is called *y-hat* and is used to indicate a predicted value of the dependent variable $y$ for a certain value of the independent variable $x$.

If a line extends uphill from left to right, the slope is a positive value, and if the line extends downhill from left to right, the slope is a negative value. Refer to Figure 14.3.

**Figure 14.3 Three Possible Graphs of $\hat{y} = a + bx$** (a) If $b > 0$, the line slopes upward to the right. (b) If $b = 0$, the line is horizontal. (c) If $b < 0$, the line slopes downward to the right.

When generating the equation of a line in algebra using $y = mx + b$, two $(x, y)$ points were required to generate the equation. However, in regression analysis, all $(x, y)$ points in the data set will be utilized to develop the linear regression model.

The first step in any regression analysis is to create the scatter plot. Then proceed to calculate the correlation coefficient $r$, and check this value for significance. If we think that the points show a linear relationship, we would like to draw a line on the scatter plot. This line can be calculated through a process called linear regression. However, we only calculate a regression line if one of the variables helps to explain or predict the other variable. If $x$ is the independent variable and $y$ the dependent variable, then we can use a regression line to predict $y$ for a given value of $x$.

As an example of a regression equation, assume that a correlation exists between the monthly amount spent

on advertising and the monthly revenue for a Fortune 500 company. After collecting (*x, y*) data for a certain time period, the company determines the regression equation is of the form

$$\hat{y} = 9{,}376.7 + 61.8x \quad \textbf{14.4}$$

where *x* represents the monthly amount spent on advertising (in thousands of dollars) and $\hat{y}$ represents the monthly revenues for the company (in thousands of dollars).

A scatter plot of the (*x, y*) data is shown in Figure 14.4.

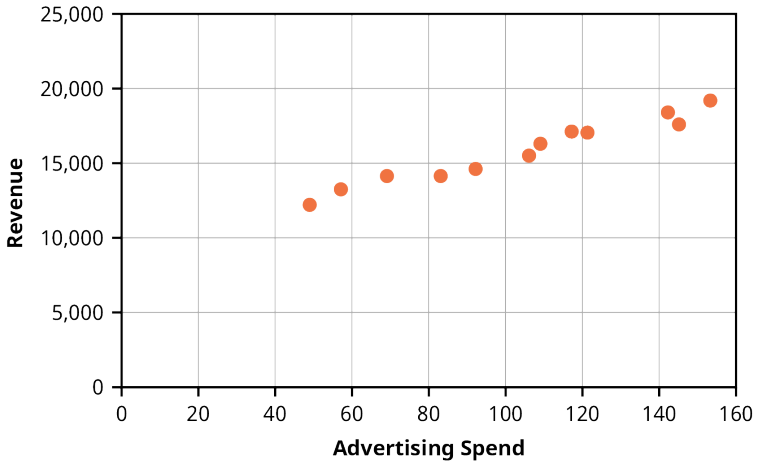



**Figure 14.4 Scatter Plot of Revenue versus Advertising for a Fortune 500 Company ($000s)**

The Fortune 500 company would like to predict the monthly revenue if its executives decide to spend $150,000 in advertising next month. To determine the estimate of monthly revenue, let $x = 150$ in the regression equation and calculate a corresponding value for $\hat{y}$:

$$\begin{aligned} \hat{y} &= 9{,}376.7 + 61.8x \\ \hat{y} &= 9{,}376.7 + 61.8(150) \\ \hat{y} &= 18{,}646.7 \end{aligned} \quad \textbf{14.5}$$

This predicted value of *y* indicates that the anticipated revenue would be $18,646,700, given the advertising spend of $150,000.

Notice that from past data, there may have been a month where the company actually did spend $150,000 on advertising, and thus the company may have an actual result for the monthly revenue. This actual, or observed, amount can be compared to the **prediction** from the linear regression model to calculate a residual.

A **residual** is the difference between an observed *y*-value and the predicted *y*-value obtained from the linear regression equation. As an example, assume that in a previous month, the actual monthly revenue for an advertising spend of $150,000 was $19,200,000, and thus $y = 19,200$. The residual for this data point can be calculated as follows:

$$\begin{aligned} \text{Residual} &= (\text{observed } y\text{-value}) - (\text{predicted } y\text{-value}) \\ \text{Residual} &= y - \hat{y} \\ \text{Residual} &= 19{,}200 - 18{,}646.7 = 553.3 \end{aligned} \quad \textbf{14.6}$$

Notice that residuals can be positive, negative, or zero. If the observed *y*-value exactly matches the predicted *y*-value, then the residual will be zero. If the observed *y*-value is greater than the predicted *y*-value, then the residual will be a positive value. If the observed *y*-value is less than the predicted *y*-value, then the residual will be a negative value.

When formulating the linear regression line of best fit to the points on the scatter plot, the mathematical analysis generates a linear equation where the sum of the squared residuals is minimized. This analysis is

referred to as the **method of least squares**. The result is that the analysis generates a linear equation that is the "best fit" to the points on the scatter plot, in the sense that the line minimizes the differences between the predicted values and observed values for *y*.

THINK IT THROUGH

### Calculating a Residual

Suppose that the chief financial officer of a corporation has created a linear model for the relationship between the company stock and interest rates. When interest rates are at 5%, the company stock has a value of $94. Using the linear model, when interest rates are at 5%, the model predicts the value of the company stock to be $99. Calculate the residual for this data point.

**Solution:**

A residual is the difference between an observed *y*-value and the predicted *y*-value obtained from the linear regression equation

$$\begin{aligned} \text{Residual} &= (\text{observed } y\text{-value}) - (\text{predicted } y\text{-value}) \\ \text{Residual} &= y - \hat{y} \\ \text{Residual} &= 94 - 99 = -5 \end{aligned} \quad \textbf{14.7}$$

The goal in the regression analysis is to determine the coefficients *a* and *b* in the following regression equation:

$$\hat{y} = a + bx \quad \textbf{14.8}$$

Once the (*x, y*) has been collected, the slope (*b*) and *y*-intercept (*a*) can be calculated using the following formulas:

$$b = \frac{n\sum xy - (\sum x)(\sum y)}{n\sum x^2 - (\sum x)^2}$$
$$a = \frac{\sum y}{n} - b\frac{\sum x}{n} \quad \textbf{14.9}$$

where *n* refers to the number of data pairs and $\sum x$ indicates sum of the *x*-values.

Notice that the formula for the *y*-intercept requires the use of the slope result (*b*), and thus the slope should be calculated first and the *y*-intercept should be calculated second.

When making predictions for *y*, it is always important to plot a scatter diagram first. If the scatter plot indicates that there is a linear relationship between the variables, then it is reasonable to use a best-fit line to make predictions for *y,* given *x* within the domain of *x*-values in the sample data, *but not necessarily for* x*-values outside that domain*.

Note: Computer spreadsheets, statistical software, and many calculators can quickly calculate the best-fit line and create the graphs. The calculations tend to be tedious if done by hand.

## Assumptions for Linear Regression

Testing the significance of the correlation coefficient requires that certain assumptions about the data are satisfied. The premise of this test is that the data are a sample of observed points taken from a larger population. We have not examined the entire population because it is not possible or feasible to do so. We are examining the sample to draw a conclusion about whether the linear relationship that we see between *x* and *y* in the sample data provides strong enough evidence that we can conclude that there is a linear relationship between *x* and *y* in the population.

The regression line equation that we calculate from the sample data gives the best-fit line for our particular sample. We want to use this best-fit line for the sample as an estimate of the best-fit line for the population (Figure 14.5). Examining the scatter plot and testing the significance of the correlation coefficient helps us determine if it is appropriate to do this.

These are the assumptions underlying the test of significance:

1. There is a linear relationship in the population that models the average value of *y* for varying values of *x*. In other words, the expected value of *y* for each particular value lies on a straight line in the population. (We do not know the equation for the line for the population. Our regression line from the sample is our best estimate of this line in the population.)
2. The *y*-values for any particular *x*-value are normally distributed about the line. This implies that there are more *y*-values scattered closer to the line than are scattered farther away. Assumption (1) implies that these normal distributions are centered on the line: the means of these normal distributions of *y*-values lie on the line.
3. The standard deviations of the population *y*-values about the line are equal for each value of *x*. In other words, each of these normal distributions of *y*-values has the same shape and spread about the line.
4. The residual errors are mutually independent (no pattern).
5. The data are produced from a well-designed, random sample or randomized experiment.

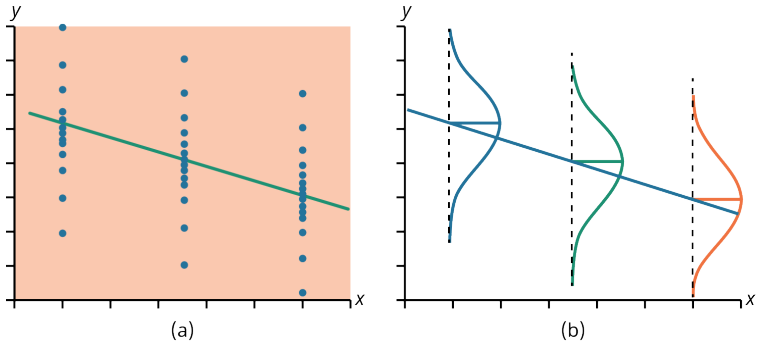



**Figure 14.5 Best-Fit Line** The *y*-values for each *x*-value are normally distributed about the line with the same standard deviation. For each *x*-value, the mean of the *y*-values lies on the regression line. More *y*-values lie near the line than are scattered further away from the line.

# 14.3 Best-Fit Linear Model

## Learning Outcomes

By the end of this section, you will be able to:

- Calculate the slope and *y*-intercept for a linear regression model using technology.
- Interpret and apply the slope and *y*-intercepts.

## Calculate the Slope and *y*-Intercept for a Linear Regression Model Using Technology

Once a correlation has been deemed as significant, a **best-fit linear regression model** is developed. The goal in the regression analysis is to determine the coefficients *a* and *b* in the following regression equation:

$$\hat{y} = a + bx \tag{14.10}$$

The slope (*b*) and *y*-intercept (*a*) can be calculated using the following formulas:

$$b = \frac{n\sum xy - (\sum x)(\sum y)}{n\sum x^2 - (\sum x)^2} \tag{14.11}$$

$$a = \frac{\sum y}{n} - b\frac{\sum x}{n}$$

These formulas can be quite cumbersome, especially for a significant number of data pairs, and thus technology is often used (such as Excel, a calculator, R statistical software, etc.).

**Using Excel:** To calculate the slope and *y*-intercept of the linear model, start by entering the (*x, y*) data in two columns in Excel. Then the Excel commands =SLOPE and =INTERCEPT can be used to calculate the slope and intercept, respectively.

The following data set will be used as an example: the monthly amount spent on advertising and the monthly revenue for a Fortune 500 company for 12 months (data is shown in Table 14.4).

| Month | Advertising Expenditure | Revenue |
|---|---|---|
| Jan | 49 | 12,210 |
| Feb | 145 | 17,590 |
| Mar | 57 | 13,215 |
| Apr | 153 | 19,200 |
| May | 92 | 14,600 |
| Jun | 83 | 14,100 |
| Jul | 117 | 17,100 |
| Aug | 142 | 18,400 |
| Sep | 69 | 14,100 |
| Oct | 106 | 15,500 |
| Nov | 109 | 16,300 |
| Dec | 121 | 17,020 |

**Table 14.4 Revenue versus Advertising for Fortune 500 Company ($000s)**

To calculate the slope of the regression model, use the Excel command

=SLOPE(*y*-data range, *x*-data range)

It's important to note that this Excel command expects that the *y*-data range is entered first and the *x*-data range is entered second. Since revenue depends on amount spent on advertising, revenue is considered the *y*-variable and amount spent on advertising is considered the *x*-variable. Notice the *y*-data is contained in cells C2 through C13 and the *x*-data is contained in cells B2 through B13. Thus the Excel command for slope would be entered as

=SLOPE(C2:C13, B2:B13)

In the same way, the Excel command to calculate the *y*-intercept of the regression model is

=INTERCEPT(*y*-data range, *x*-data range)

For the data set shown in the above table, the Excel command would be

=INTERCEPT(C2:C13, B2:B13)

The results are shown in Figure 14.6, where

$$\text{slope } b = 61.8$$
$$\text{intercept } a = 9{,}376.7 \quad \textbf{14.12}$$

| | A | B | C |
|---|---|---|---|
| 1 | **Month** | **Advertising Expenditure** | **Revenue** |
| 2 | Jan | 49 | 12,210 |
| 3 | Feb | 145 | 17,590 |
| 4 | Mar | 57 | 13,215 |
| 5 | Apr | 153 | 19,200 |
| 6 | May | 92 | 14,600 |
| 7 | Jun | 83 | 14,100 |
| 8 | Jul | 117 | 17,100 |
| 9 | Aug | 142 | 18,400 |
| 10 | Sep | 69 | 14,100 |
| 11 | Oct | 106 | 15,500 |
| 12 | Nov | 109 | 16,300 |
| 13 | Dec | 121 | 17,020 |
| 14 | | | |
| 15 | | **=SLOPE(C2:C13,B2:B13)** | **=INTERCEPT(C2:C13,B2:B13)** |
| 16 | | **61.8** | **9,376.7** |

**Figure 14.6 Revenue versus Advertising for Fortune 500 Company ($000s) Showing Slope and *y*-Intercept Calculation in Excel**

Based on this, the regression equation can be written as

$$\hat{y} = a + bx \quad \textbf{14.13}$$
$$\hat{y} = 9{,}376.7 + 61.8x$$

where $x$ represents the amount spent on advertising (in thousands of dollars) and $y$ represents the amount of revenue (in thousands of dollars).

## Using a Financial Calculator

The financial calculator provides the slope and *y*-intercept for the linear regression model once the (*x*, *y*) data is inputted into the calculator.

Follow the steps in Table 14.5 for calculating the slope and *y*-intercept for the data set of amounts spent on advertising and revenue shown previously.

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 1 | Enter [DATA] entry mode | 2ND [DATA] | X01 | 0.00 |
| 2 | Clear any previous data | 2ND [CLR WORK] | X01 | 0.00 |
| 3 | Enter first *x*-value of 49 | 49 ENTER | X01 = | 49.00 |
| 4 | Move to next data entry | ↓ | Y01 = | 1.00 |
| 5 | Enter first *y*-value of 12210 | 12210 ENTER | Y01 = | 12,210.00 |
| 6 | Move to next data entry | ↓ | X02 | 0.00 |
| 7 | Enter second *x*-value of 145 | 145 ENTER | X02 = | 145.00 |
| 8 | Move to next data entry | ↓ | Y02 = | 1.00 |

**Table 14.5 Calculator Steps for the Slope and y-Intercept**

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 9 | Enter second *y*-value of 17590 | 17590ENTER | Y02 = | 17,590.00 |
| 10 | Move to next data entry | ↓ | X03 | 0.00 |
| 11 | Continue to enter remaining data values | | | |
| 12 | Enter [STAT] mode | 2ND [STAT] | | |
| 13 | Press [SET] until LIN appears | 2ND [SET] | LIN | |
| 14 | Move to 1st statistical result | ↓ | $n =$ | 12.00 |
| 15 | Move to next statistical result | ↓ | $\overline{x} =$ | 103.58 |
| 16 | Continue to scroll down until the value of *a* is displayed | ↓ | $a =$ | 9,376.70 |
| 17 | Continue to scroll down until the value of *b* is displayed | ↓ | $b =$ | 61.80 |

**Table 14.5 Calculator Steps for the Slope and y-Intercept**

From the statistical results shown on the calculator display, the slope *b* is 61.8 and the *y*-intercept *a* is 9,367.7.

Based on this, the regression equation can be written as

$$\hat{y} = a + bx \quad \textbf{14.14}$$
$$\hat{y} = 9{,}376.7 + 61.8x$$

## Interpret and Apply the Slope and *y*-Intercept

The slope of the line, *b*, describes how changes in the variables are related. It is important to interpret the slope of the line in the context of the situation represented by the data. You should be able to write a sentence interpreting the slope in plain English.

### Interpretation of the Slope

The slope of the best-fit line tells us how the dependent variable (*y*) changes for every one unit increase in the independent (*x*) variable, on average.

In the previous example, the linear regression model for the monthly amount spent on advertising and the monthly revenue for a Fortune 500 company for 12 months was generated as follows:

$$\hat{y} = a + bx \quad \textbf{14.15}$$
$$\hat{y} = 9,376.7 + 61.8x$$

Since the slope was determined to be 61.8, the company can interpret this to mean that for every $1,000 dollars spent on advertising, on average, this will result in an increase in revenues of $61,800.

The intercept of the regression equation is the corresponding *y*-value when.

### Interpretation of the Intercept

The intercept of the best-fit line tells us the expected mean value of *y* in the case where the *x*-variable is equal to zero.

However, in many scenarios it may not make sense to have the *x*-variable equal zero, and in these cases, the intercept does not have any meaning in the context of the problem. In other examples, the *x*-value of zero is outside the range of the *x*-data that was collected. In this case, we should not assign any interpretation to the *y*-intercept.

In the previous example, the range of data collected for the *x*-variable was from $49 to $153 spent per month on advertising. Since this interval does not include an *x*-value of zero, we would not provide any interpretation for the intercept.

# 14.4 Regression Applications in Finance

## Learning Outcomes

By the end of this section, you will be able to:

- Calculate the regression model for a single independent variable as applied to financial forecasting.
- Extract measures of slope and intercept from regression analysis in financial applications.

## Regression Model for a Single Independent Variable

Regression analysis is used extensively in finance-related applications. Many typical applications involve determining if there is a correlation between various stock market indices such as the S&P 500, the Dow Jones Industrial Average (DJIA), and the Russell 2000 index.

As an example, suppose we would like to determine if there is a correlation between the Russell 2000 index and the DJIA. Does the value of the Russell 2000 index depend on the value of the DJIA? Is it possible to predict the value of the Russell 2000 index for a certain value of the DJIA? We can explore these questions using regression analysis.

Table 14.6 shows a summary of monthly closing prices of the DJIA and the Russell 2000 for a 12-month time period. We consider the DJIA to be the independent variable and the Russell 2000 index to be the dependent variable.

| Monthly Close | DJIA | Russell 2000 |
|---|---|---|
| 1-Apr-21 | 34,200.67 | 2,262.67 |
| 1-Mar-21 | 32,981.55 | 2,220.52 |
| 1-Feb-21 | 30,932.37 | 2,201.05 |
| 1-Jan-21 | 29,982.62 | 2,073.64 |
| 1-Dec-20 | 30,606.48 | 1,974.86 |
| 1-Nov-20 | 29,638.64 | 1,819.82 |
| 1-Oct-20 | 26,501.60 | 1,538.48 |
| 1-Sep-20 | 27,781.70 | 1,507.69 |
| 1-Aug-20 | 28,430.05 | 1,561.88 |
| 1-Jul-20 | 26,428.32 | 1,480.43 |
| 1-Jun-20 | 25,812.88 | 1,441.37 |
| 1-May-20 | 25,383.11 | 1,394.04 |

**Table 14.6 Monthly Closing Prices of the DJIA and the Russell 2000 for a 12-Month Time Period** (source: Yahoo! Finance)

The first step is to create a scatter plot to determine if the data points appear to follow a linear pattern. The scatter plot is shown in Figure 14.7. The scatter plot clearly shows a linear pattern; the next step is to calculate the correlation coefficient and determine if the correlation is significant.

- Using the Excel command =CORREL, the correlation coefficient is calculated to be 0.947. This value of the correlation coefficient is significant using the test for significance referenced earlier in Correlation Analysis.
- Using the Excel commands =SLOPE and =INTERCEPT, the value of the slope and $y$-intercept are calculated as 0.11 and $-1{,}496.34$, respectively, when rounded to two decimal places.

The Excel output is shown below:

=CORREL(C3:C14,B3:B14): 0.947

=SLOPE(C3:C14,B3:B14): 0.113

=INTERCEPT(C3:C14,B3:B14): -1,496.340

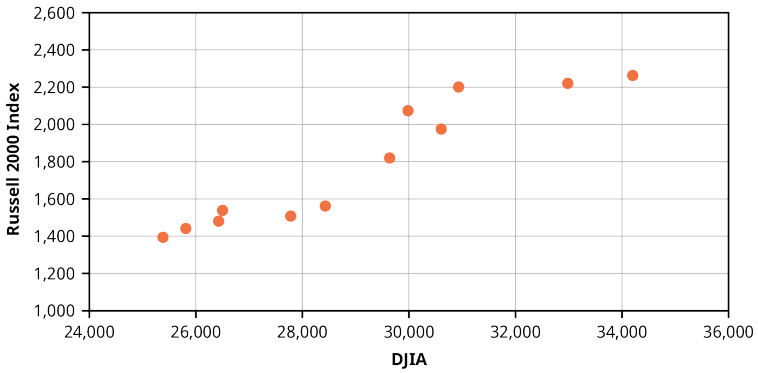



**Figure 14.7 Scatter Plot for Monthly Closing Prices of the DJIA versus the Russell 2000 for a 12-Month Time Period** (data source: Yahoo! Finance)

Based on these results, the corresponding linear regression model is

$$\hat{y} = a + bx \qquad \textbf{14.16}$$
$$\hat{y} = -1{,}496.34 + 0.11x$$

Assume the DJIA has reached a value of 32,000. Predict the corresponding value of the Russell 2000 index. To determine this, substitute the value of the independent variable, $x = 32{,}000$ (this is the given value of the DJIA), and calculate the corresponding value for the dependent variable, which is the predicted value for the Russell 2000 index:

$$\hat{y} = -1{,}496.34 + 0.11(32{,}000) \qquad \textbf{14.17}$$
$$\hat{y} = 2{,}023.66$$

Thus the predicted value for the Russell 2000 index is approximately 2,024 when the DJIA reached a value of 32,000.

## Measures of Slope and Intercept from Regression Analysis

An important application of regression analysis is to determine the systematic risk for a particular stock, which is referred to as **beta**. A stock's beta is a measure of the volatility of the stock compared to a benchmark such as the S&P 500 index. If a stock has more volatility compared to the benchmark, then the stock will have a beta greater than 1.0. If a stock has less volatility compared to the benchmark, then the stock will have a beta less than 1.0.

Beta can be determined as the slope of the regression line when the stock returns are plotted versus the returns for the benchmark, such as the S&P 500. As an example, consider the calculation for beta of Nike stock based on monthly returns of Nike stock versus monthly returns for the S&P 500 over the time period from May 2020 to March 2021. The monthly return data is shown in Table 14.7.

| Date | S&P 500 | S&P Monthly Return (%) | Nike Stock Price ($) | Nike Monthly Return (%) |
|---|---|---|---|---|
| 4/1/2020 | 2,912.43 | N/A | 87.18 | N/A |
| 5/1/2020 | 3,044.31 | 0.05 | 98.58 | 0.13 |
| 6/1/2020 | 3,100.29 | 0.02 | 98.05 | -0.01 |
| 7/1/2020 | 3,271.12 | 0.06 | 97.61 | 0.00 |
| 8/1/2020 | 3,500.31 | 0.07 | 111.89 | 0.15 |
| 9/1/2020 | 3,363.00 | -0.04 | 125.54 | 0.12 |
| 10/1/2020 | 3,269.96 | -0.03 | 120.08 | -0.04 |
| 11/1/2020 | 3,621.63 | 0.11 | 134.70 | 0.12 |
| 12/1/2020 | 3,756.07 | 0.04 | 141.47 | 0.05 |
| 1/1/2021 | 3,714.24 | -0.01 | 133.59 | -0.06 |
| 2/1/2021 | 3,811.15 | 0.03 | 134.78 | 0.01 |
| 3/1/2021 | 3,943.34 | 0.03 | 140.45 | 0.04 |
| 3/12/2021 | 3,943.34 | 0.00 | 140.45 | 0.00 |

**Table 14.7 Monthly Returns of Nike Stock versus Monthly Returns for the S&P 500** (source: Yahoo! Finance)

The scatter plot that graphs S&P monthly return versus Nike monthly return is shown in Figure 14.8.

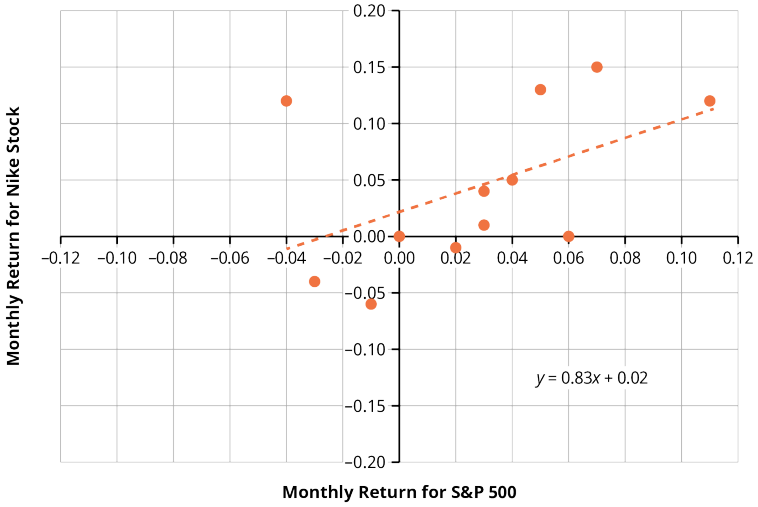



**Figure 14.8 Scatter Plot of Monthly Returns of Nike Stock versus Monthly Returns for the S&P 500 ($)** (data source: Yahoo! Finance)

The slope of the regression line is 0.83, obtained by using the =SLOPE command in Excel.

```
=SLOPE (E4:E15,C4:C15)

=0.830681658
```

This indicates the value of beta for Nike stock is 0.83, which indicates that Nike stock had lower volatility versus the S&P 500 for the time period of interest.

# 14.5 Predictions and Prediction Intervals

## Learning Outcomes

By the end of this section, you will be able to:

- Calculate predictions for the dependent variable using the regression model.
- Generate prediction intervals based on a prediction for the dependent variable.

## Predicting the Dependent Variable Using the Regression Model

A key aspect of generating the linear regression model is to use the model for predictions, provided the correlation is significant. To generate predictions or forecasts using the linear regression model, substitute the value of the independent variable ($x$) in the regression equation and solve the equation for the dependent variable ($y$).

In a previous example, the linear regression equation was generated to relate the amount of monthly revenue for a Fortune 500 company to the amount of monthly advertising spend. From the previous example, it was determined that the regression equation can be written as

$$\begin{aligned} \hat{y} &= a + bx \\ \hat{y} &= 9{,}376.7 + 61.8x \end{aligned} \tag{14.18}$$

where $x$ represents the amount spent on advertising (in thousands of dollars) and $y$ represents the amount of revenue (in thousands of dollars).

Let's assume the Fortune 500 company would like to predict the monthly revenue for a month where it plans to spend \$80,000 for advertising. To determine the estimate of monthly revenue, let $x = 80$ in the regression equation and calculate a corresponding value for $\hat{y}$:

$$\begin{aligned} \hat{y} &= 9{,}376.7 + 61.8x \\ \hat{y} &= 9{,}376.7 + 61.8(80) \\ \hat{y} &= 14{,}320.70 \end{aligned} \tag{14.19}$$

This predicted value of $y$ indicates that the forecasted revenue would be \$14,320,700, assuming an advertising spend of \$80,000.

- Excel can provide this forecasted value directly using the =FORECAST command.
- To use this command, enter the value of the independent variable $x$, followed by the cell range for the $y$-data and the cell range for the $x$-data, as follows: `=FORECAST(X_VALUE, Range of Y-DATA, Range of X-DATA)`
- Using this Excel command, the forecasted value for the revenue is \$14,320.52 when the advertising spend is \$80 (in thousands of dollars) (see Figure 14.9). (Note: The discrepancy in the more precise Excel result and the formula result is due to rounding in interim calculations.)

| | A | B | C |
|---|---|---|---|
| 1 | **Month** | **Advertising Expenditure** | **Revenue** |
| 2 | Jan | 49 | 12,210 |
| 3 | Feb | 145 | 17,590 |
| 4 | Mar | 57 | 13,215 |
| 5 | Apr | 153 | 19,200 |
| 6 | May | 92 | 14,600 |
| 7 | Jun | 83 | 14,100 |
| 8 | Jul | 117 | 17,100 |
| 9 | Aug | 142 | 18,400 |
| 10 | Sep | 69 | 14,100 |
| 11 | Oct | 106 | 15,500 |
| 12 | Nov | 109 | 16,300 |
| 13 | Dec | 121 | 17,020 |
| 14 | | | |
| 15 | | **=FORECAST(80,C2:C13,B2:B13)** | **14,320.52** |

**Figure 14.9 Revenue versus Advertising for Fortune 500 Company ($000s) Showing FORECAST Command in Excel**

A word of caution when predicting values for *y*: it is generally recommended to only predict values for *y* using values of *x* that are in the original range of the data collection.

As an example, assume we have developed a linear model to predict the height of male children based on their age. We have collected data for the age range from $x = 3$ years old to $x = 10$ years old, and we have confirmed that the scatter plot shows a linear trend and that the correlation is significant.

It would be erroneous to use this model to predict the height of a 25-year-old male since $x = 25$ is outside the range of the *x*-data, which was from 3 to 10 years old. The reason this is not recommended is that a linear pattern cannot be assumed to continue beyond the *x*-value of 10 years old unless some data collection has occurred at ages greater than 10 to confirm that the linear pattern is consistent for *x*-values beyond 10 years old.

## Generating Prediction Intervals

One important value of an estimated regression equation is its ability to predict the effects on *y* of a change in one or more values of the independent variables. The value of this is obvious. Careful policy cannot be made without estimates of the effects that may result. Indeed, it is the desire for particular results that drive the formation of most policy. Regression models can be, and have been, invaluable aids in forming such policies.

Remember that point estimates do not carry a particular level of probability, or level of confidence, because points have no "width" above which there is an area to measure. There are actually two different approaches to the issue of developing estimates of changes in the independent variable (or variables) on the dependent variable. The first approach wishes to measure the expected mean value of *y* from a specific change in the value of *x*.

The second approach to estimate the effect of a specific value of *x* on *y* treats the event as a single experiment: you choose *x* and multiply it times the coefficient, and that provides a single estimate of *y*. Because this approach acts as if there were a single experiment, the variance that exists in the parameter estimate is larger than the variance associated with the expected value approach.

The conclusion is that we have two different ways to predict the effect of values of the independent variable(s) on the dependent variable, and thus we have two different intervals. Both are correct answers to the question

being asked, but there are two different questions. To avoid confusion, the first case where we are asking for the expected value of the mean of the estimated *y* is called a *confidence interval*. The second case, where we are asking for the estimate of the impact on the dependent variable *y* of a single experiment using a value of *x,* is called the *prediction interval*.

The prediction interval for an individual *y* for $x = x_p$ can be calculated as

$$\hat{y} = \pm t_{\alpha/2} s_e \sqrt{1 + \frac{1}{n} + \frac{(x_p - \overline{x})^2}{s_x}} \quad \textbf{14.20}$$

where $s_e$ is the standard deviation of the error term, $s_x$ is the standard deviation of the *x*-variable, and $t_{\alpha/2}$ is the critical value of the t-distribution at the $1 - \alpha$ confidence level.

Tabulated values of the t-distribution are available in online references such as the Engineering Statistics Handbook (https://openstax.org/r/engineering_handbook). The mathematical computations for prediction intervals are complex, and usually the calculations are performed using software. The formula above can be implemented in Excel to create a 95% prediction interval for the forecast for monthly revenue when $x = \$80{,}000$ is spent on monthly advertising. Figure 14.10 shows the detailed calculations in Excel to arrive at a 95% prediction interval of (13,270.95, 15,370.09) for the monthly revenue. (The commands refer to the Excel data table shown in Figure 14.9.)

| | E | F | G | H |
|---|---|---|---|---|
| 1 | **Calculations for 95% Prediction Interval** | | | |
| 2 | **Measurement** | **Symbol** | **Value** | **Excel Command** |
| 3 | Sample size | *n* | 12 | =COUNT(C2:C13) |
| 4 | Degrees of freedom | df | 10 | =G3 - 2 |
| 5 | X-bar | | 103.583333 | =AVERAGE(B2:B13) |
| 6 | Standard error | $S_e$ | 443.92908 | =STEYX(C2:C13,B2:B13) |
| 7 | Squared deviations of *x* | $SS_x$ | 13,054.917 | =DEVSQ(B2:B13) |
| 8 | Value of *x* for prediction | *x* | 80 | NA |
| 9 | Forecasted value of *y* | | 14,320.520 | =FORECAST(80,C2:C13,B2:B13) |
| 10 | Value of t-distribution | | 2.22813885 | =ABS(T.INV(0.025,G4)) |
| 11 | Margin of error | E | 1,049.573 | =G10*G6*SQRT(1+1/G3+(G8-G5)^2/G7) |
| 12 | | | | |
| 13 | **Lower Bound** | | **13,270.946** | =G9-G11 |
| 14 | **Upper Bound** | | **15,370.093** | =G9+G11 |

**Figure 14.10 Calculations for 95% Prediction Interval for Monthly Revenue**

This prediction interval can be interpreted as follows: there is 95% confidence that when the amount spent on monthly advertising is $80,000, the corresponding monthly revenue will be between $13,270.95 and $15,370.09.

Various computer regression software packages provide programs within the regression functions to provide answers to inquiries of estimated predicted values of *y* given various values chosen for the *x*-variable(s). For example, the statistical program R provides these prediction intervals directly. It is important to know just which interval is being tested in the computer package because the difference in the size of the standard deviations will change the size of the interval estimated. This is shown in Figure 14.11.

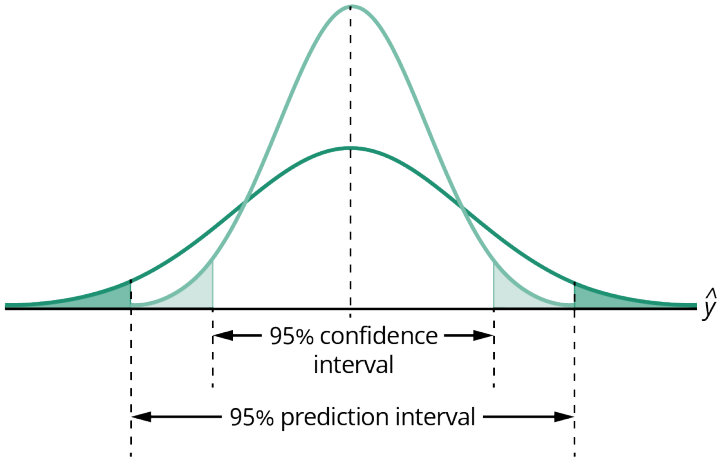



**Figure 14.11 Prediction and Confidence Intervals for Regression Equation at 95% Confidence Level**

Figure 14.11 shows visually the difference the standard deviation makes in the size of the estimated intervals. The confidence interval, measuring the expected value of the dependent variable, is smaller than the prediction interval for the same level of confidence. The expected value method assumes that the experiment is conducted multiple times rather than just once, as in the other method. The logic here is similar, although not identical, to that discussed when developing the relationship between the sample size and the confidence interval using the central limit theorem. There, as the number of experiments increased, the distribution narrowed, and the confidence interval became tighter around the expected value of the mean.

It is also important to note that the intervals around a point estimate are highly dependent upon the range of data used to estimate the equation, regardless of which approach is being used for prediction. Remember that all regression equations go through the point of means—that is, the mean value of *y* and the mean values of all independent variables in the equation. As the value of *x* gets further and further from the (*x*, *y*) point corresponding to the mean value of *x* and the mean value of *y*, the width of the estimated interval around the point estimate increases. Choosing values of *x* beyond the range of the data used to estimate the equation poses an even greater danger of creating estimates with little use, very large intervals, and risk of error. Figure 14.12 shows this relationship.

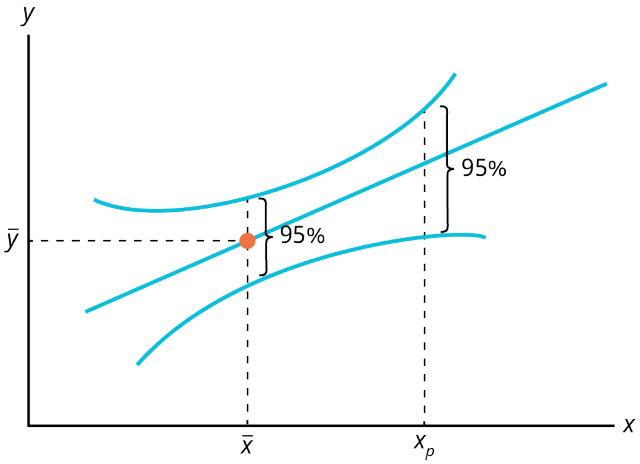



**Figure 14.12 Confidence Interval for an Individual Value of *x*, $X_p$, at 95% Confidence Level**

Figure 14.12 demonstrates the concern for the quality of the estimated interval, whether it is a prediction interval or a confidence interval. As the value chosen to predict *y*, $X_p$ in the graph, is further from the central weight of the data, $\overline{X}$, we see the interval expand in width even while holding constant the level of confidence. This shows that the precision of any estimate will diminish as one tries to predict beyond the largest weight of the data and most certainly will degrade rapidly for predictions beyond the range of the data. Unfortunately,

this is just where most predictions are desired. They can be made, but the width of the confidence interval may be so large as to render the prediction useless.

# 14.6 Use of R Statistical Analysis Tool for Regression Analysis

## Learning Outcomes

By the end of this section, you will be able to:

- Generate correlation coefficients using the R statistical tool.
- Generate linear regression models using the R statistical tool.

## Generate Correlation Coefficients Using the R Statistical Tool

R is an open-source statistical analysis tool that is widely used in the finance industry. R is available as a free program and provides an integrated suite of functions for data analysis, graphing, and statistical programming. R provides many functions and capabilities for regression analysis.

Recall that most calculations in R are handled via functions.

The typical method for using functions in statistical applications is to first create a vector of data values. There are several ways to create vectors in R. For example, the c function is often used to combine values into a vector. For example, this R command will generate a vector called salaries, containing the data values 40,000, 50,000, 75,000, and 92,000:

```
> salaries <- c(40000, 50000, 75000, 92000)
```

To calculate the correlation coefficient *r*, we use the R command called *cor*.

As an example, consider the data set in Table 14.8, which tracks the return on the S&P 500 versus return on Coca-Cola stock for a seven-month time period.

| Month | S&P 500 Monthly Return (%) | Coca-Cola Monthly Return (%) |
|---|---|---|
| Jan | 8 | 6 |
| Feb | 1 | 0 |
| Mar | 0 | -2 |
| Apr | 2 | 1 |
| May | -3 | -1 |
| Jun | 7 | 8 |
| Jul | 4 | 2 |

**Table 14.8 Monthly Returns of Coca-Cola Stock versus Monthly Returns for the S&P 500**

Create two vectors in R, one vector for the S&P 500 returns and a second vector for Coca-Cola returns:

```
> SP500 <- c(8,1,0,2,-3,7,4)
```

```
> CocaCola <- c(6,0,-2,1,-1,8,2)
```

The R command called *cor* returns the correlation coefficient for the *x*-data vector and *y*-data vector:

```
> cor(SP500, CocaCola)
```

## Generate Linear Regression Models Using the R Statistical Tool

To create a linear model in R, assuming the correlation is significant, the command *lm* (for linear model) will provide the slope and *y*-intercept for the linear regression equation.

The format of the R command is

```
lm(dependent_variable_vector ~ independent_variable_vector)
```

Notice the use of the tilde symbol as the separator between the dependent variable vector and the independent variable vector.

We use the returns on Coca-Cola stock as the dependent variable and the returns on the S&P 500 as the independent variable, and thus the R command would be

```
> lm(CocaCola ~ SP500)

Call:

lm(formula = CocaCola ~ SP500)

Coefficients:

(Intercept) SP500

-0.3453 0.8641
```

The R output provides the value of the *y*-intercept as $-0.3453$ and the value of the slope as 0.8641. Based on this, the linear model would be

$$\begin{aligned} \hat{y} &= a + bx \\ \hat{y} &= -0.3453 + 0.8641x \end{aligned} \tag{14.21}$$

where *x* represents the value of S&P 500 return and *y* represents the value of Coca-Cola stock return.

The results can also be saved as a formula and called “model” using the following R command. To obtain more detailed results for the linear regression, the *summary* command can be used, as follows:

```
> model <- lm(CocaCola ~ SP500)

> summary(model)

Call:

lm(formula = CocaCola ~ SP500)
```

```
Residuals:

1 2 3 4 5 6 7

-0.5672 -0.5188 -1.6547 -0.3828 1.9375 2.2969 -1.1109

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) -0.3453 0.7836 -0.441 0.67783

SP500 0.8641 0.1734 4.984 0.00416 **

---

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.658 on 5 degrees of freedom

Multiple R-squared: 0.8325, Adjusted R-squared: 0.7989

F-statistic: 24.84 on 1 and 5 DF, p-value: 0.004161
```

In this output, the *y*-intercept and slope is given, as well as the residuals for each *x*-value. The output includes additional statistical details regarding the regression analysis.

Predicted values and prediction intervals can also be generated within R.

First, we can create a structure in R called a data frame to hold the values of the independent variable for which we want to generate a prediction. For example, we would like to generate the predicted return for Coca-Cola stock, given that the return for the S&P 500 is 6.

We use the R command called *predict*.

To generate a prediction for the linear regression equation called *model*, using the data frame where the value of the S&P 500 is 6, the R commands will be

```
> a <- data.frame(SP500=6)

> predict(model, a)

1

4.839062
```

The output from the *predict* command indicates that the predicted return for Coca-Cola stock will be 4.8% when the return for the S&P 500 is 6%.

We can extend this analysis to generate a 95% prediction interval for this result by using the following R command, which adds an option to the *predict* command to generate a prediction interval:

```
> predict(model,a, interval="predict")

fit lwr upr

1 4.839062 0.05417466 9.62395
```

Thus the 95% prediction interval for Coca-Cola return is (0.05%, 9.62%) when the return for the S&P 500 is 6%.

# Summary

## 14.1 Correlation Analysis

Correlation is the measure of association between two numeric variables. A correlation coefficient called *r* is used to assess the strength and direction of the correlation. The value of *r* is always between $-1$ and $+1$. The size of the correlation *r* indicates the strength of the linear relationship between the two variables. Values of *r* close to $-1$ or to $+1$ indicate a stronger linear relationship. A positive value of *r* means that when *x* increases, *y* tends to increase and when *x* decreases, *y* tends to decrease (positive correlation). A negative value of *r* means that when *x* increases, *y* tends to decrease and when *x* decreases, *y* tends to increase (negative correlation).

## 14.2 Linear Regression Analysis

Linear regression analysis uses a straight-line fit to model the relationship between the two variables. Once a straight-line model is developed, this model can then be used to predict the value of the dependent variable for a specific value of the independent variable. Two parameters are calculated for the linear model, the slope of the best-fit line and the *y*-intercept of the best-fit line. The method of least squares is used to generate these parameters; this method is based on minimizing the squared differences between the predicted values and observed values for *y*.

## 14.3 Best-Fit Linear Model

Once a correlation has been deemed significant, a linear regression model is developed. The goal in the regression analysis is to determine the coefficients *a* and *b* in the following regression equation: $\hat{y} = a + bx$. Typically some technology, such as Excel, R statistical tool, or a calculator, is used to generate the coefficients *a* and *b* since manual calculations are cumbersome.

## 14.4 Regression Applications in Finance

Regression analysis is used extensively in finance-related applications. Many typical applications involve determining if there is a correlation between various stock market indices such as the S&P 500, the DJIA, and the Russell 2000 index. The procedure is to first generate a scatter plot to determine if a visual trend is observed, then calculate a correlation coefficient and check for significance. If the correlation coefficient is significant, a linear model can then be generated and used for predictions.

## 14.5 Predictions and Prediction Intervals

A key aspect of generating the linear regression model is to then use the model for predictions, provided that the correlation is significant. To generate predictions or forecasts using the linear regression model, substitute the value of the independent variable (*x*) in the regression equation and solve the equation for the dependent variable (*y*). When making predictions using the linear model, it is generally recommended to only predict values for *y* using values of *x* that are in the original range of the data collection.

## 14.6 Use of R Statistical Analysis Tool for Regression Analysis

R is an open-source statistical analysis tool that is widely used in the finance industry and can be found online (https://openstax.org/r/finance_industry). R provides an integrated suite of functions for data analysis, graphing, and correlation and regression analysis. R is increasingly being used as a data analysis and statistical tool because it is an open-source language and additional features are constantly being added by the user community. The tool can be used on many different computing platforms.

# Key Terms

**best-fit linear regression model** an equation of the form $\hat{y} = a + bx$ that provides the best-fit straight line to the (*x*, *y*) data points

**beta** the measure of the volatility of a stock as compared to a benchmark such as the S&P 500 index

**correlation** the measure of association between two numeric variables
**correlation coefficient** a measure of the strength and direction of the linear relationship between two variables
**linear correlation** a measure of the association between two variables that exhibit an approximate straight-line fit when plotted on a scatter plot
**method of least squares** a mathematical method to generate a linear equation that is the "best fit" to the points on the scatter plot in the sense that the line minimizes the differences between the predicted values and observed values for *y*
**prediction** a forecast for the dependent variable based on a specific value of the independent variable generated using the linear model
**residual** the difference between an observed *y*-value and the predicted *y*-value obtained from the linear regression equation
**scatter plot (scatter diagram)** graphical display that shows values of the independent variable plotted on the *x*-axis and values of the dependent variable plotted on the *y*-axis

## Multiple Choice

1. Two correlation coefficients are compared: Correlation Coefficient A is 0.83. Correlation Coefficient B is $-0.91$. Which correlation coefficient represents the stronger linear relationship?
   **a.** Correlation Coefficient A
   **b.** Correlation Coefficient B
   **c.** equal strength
   **d.** not enough information to determine

2. A data set containing 10 pairs of (*x*, *y*) data points is analyzed, and the correlation coefficient is calculated to be 0.58. Does this value of $r = 0.58$ indicate a significant or nonsignificant correlation?
   **a.** significant
   **b.** nonsignificant
   **c.** neither significant nor nonsignificant
   **d.** not enough information to determine

3. A linear regression model is developed, and for $x = 10$, the corresponding predicted *y*-value is 22.7. The actual observed value for $x = 10$ is $y = 31.3$. Is the residual for this data point positive, negative, or zero?
   **a.** positive
   **b.** negative
   **c.** zero
   **d.** not enough information to determine

4. A linear model is developed for the relationship between salary of finance professionals and years of experience. The data was collected based on years of experience ranging from 1 to 15. Assuming the correlation is significant, should the linear model be used to predict the salary for a person with 25 years of experience?
   **a.** It is acceptable to predict the salary for a person with 25 years of experience.
   **b.** A linear model cannot be created for these two variables.
   **c.** It is not recommended to predict the salary for a person with 25 years of experience.
   **d.** There is not enough information to determine the answer.

5. Which of the following is the best interpretation for the slope of the linear regression model?
   **a.** The slope is the expected mean value of *y* when the *x*-variable is equal to zero.
   **b.** The slope indicates the change in *y* for every unit increase in *x*.
   **c.** The slope indicates the strength of the linear relationship between *x* and *y*.
   **d.** The slope indicates the direction of the linear relationship between *x* and *y*.

6. A linear model is developed for the relationship between the annual salary of finance professionals and years of experience, and the following is the linear model $\hat{y} = 55{,}000 + 1{,}000x$. Which is the correct interpretation of this linear model?
   **a.** slope $= 55{,}000$, $y$-intercept $= 1{,}000$
   **b.** slope $= 55$, $y$-intercept $= 1{,}000$
   **c.** slope $= 1{,}000$, $y$-intercept $= 55$
   **d.** slope $= 1{,}000$, $y$-intercept $= 55{,}000$

7. Which of the following is the correct sequence of steps needed to create a linear regression model?
   **a.** create scatter plot, calculate correlation coefficient, check for significance, create linear model
   **b.** create linear model, calculate correlation coefficient, check for significance, create scatter plot
   **c.** check for significance, create linear model, calculate correlation coefficient, create scatter plot
   **d.** create scatter plot, check for significance, create linear model, calculate correlation coefficient

8. A linear model is developed for the relationship between the annual salary of finance professionals and years of experience, and the linear model is: $\hat{y} = 55{,}000 + 1{,}000x$. The correlation is determined to be significant. Predict the salary for a finance professional with 7 years of experience.
   **a.** $55,010
   **b.** $60,000
   **c.** $62,000
   **d.** $125,000

9. As predictions are made for $x$-values that are further and further away from the mean of $x$, which is true about the prediction intervals for these $x$-values?
   **a.** The prediction intervals will become smaller.
   **b.** The prediction intervals will become larger.
   **c.** The prediction intervals will remain the same.
   **d.** There is not enough information to determine the answer.

10. Which of the following is the R command to calculate the correlation coefficient $r$?
    **a.** *correl*
    **b.** *cor*
    **c.** *slope*
    **d.** *lm*

11. Which of the following is the R command to calculate the slope and $y$-intercept for a linear regression model?
    **a.** *cor*
    **b.** *slope*
    **c.** *lm*
    **d.** *intercept*

## Review Questions

1. A correlation coefficient is calculated as $-0.92$. Provide an interpretation for this correlation coefficient.
2. Explain what a residual is and how this relates to the best-fit regression model.
3. Explain how to interpret the slope of the best-fit line.
4. Explain how to generate a prediction using a linear regression model.
5. Will the sign of the correlation coefficient always be the same as the sign of the slope of the best-fit linear regression model?

## Problems

1. A Fortune 500 company is tracking revenues versus cash flow for recent years, and the data is shown in the table below. Consider cash flow to be the dependent variable. Create a scatter plot of the data set, comment on the correlation between these two variables, and comment on the correlation for this data (all dollar amounts are in thousands).

| Revenues ($000s) | Cash Flow ($000s) |
|---|---|
| 237 | 82 |
| 241 | 86 |
| 229 | 77 |
| 284 | 94 |
| 307 | 93 |

**Table 14.9**

2. A Fortune 500 company is tracking revenues versus cash flow for recent years, and the data is shown in the table below. Consider cash flow to be the dependent variable. Calculate the correlation coefficient for this data (all dollar amounts are in thousands).

| Revenues ($000s) | Cash Flow ($000s) |
|---|---|
| 237 | 82 |
| 241 | 86 |
| 229 | 77 |
| 284 | 94 |
| 307 | 93 |

**Table 14.10**

3. A chief financial officer calculates the correlation coefficient for bond prices versus interest rate as -0.71. The data set contained nine ($x$, $y$) data points. Determine if the correlation is significant or not significant at the 0.05 level of significance.

4. A Fortune 500 company is tracking revenues versus cash flow for recent years, and the data is shown in the table below. Consider cash flow to be the dependent variable. Determine the best-fit linear regression equation for this data set (all dollar amounts are in thousands).

| Revenues ($000s) | Cash Flow ($000s) |
|---|---|
| 237 | 82 |
| 241 | 86 |
| 229 | 77 |
| 284 | 94 |
| 307 | 93 |

**Table 14.11**

5. A Fortune 500 company is tracking revenues versus cash flow for recent years, and the data is shown in the table below. Consider cash flow to be the dependent variable. Assume the correlation is significant.

Predict the cash flow for company revenues of $250,000 (all dollar amounts are in thousands).

| Revenues ($000s) | Cash Flow ($000s) |
|---|---|
| 237 | 82 |
| 241 | 86 |
| 229 | 77 |
| 284 | 94 |
| 307 | 93 |

**Table 14.12**

6. A Fortune 500 company is tracking revenues versus cash flow for recent years, and the data is shown in the table below. Consider cash flow to be the dependent variable. Assume the correlation is significant. Predict the cash flow for company revenues of $750,000 (all dollar amounts are in thousands).

| Revenues ($000s) | Cash Flow ($000s) |
|---|---|
| 237 | 82 |
| 241 | 86 |
| 229 | 77 |
| 284 | 94 |
| 307 | 93 |

**Table 14.13**

7. A Fortune 500 company is tracking revenues versus cash flow for recent years, and the data is shown in the table below. Consider cash flow to be the dependent variable. Calculate the residual for the revenue value of $284,000 (all dollar amounts are in thousands):

| Revenues ($000s) | Cash Flow ($000s) |
|---|---|
| 237 | 82 |
| 241 | 86 |
| 229 | 77 |
| 284 | 94 |
| 307 | 93 |

**Table 14.14**

## Video Activity

### Simple Linear Regression

Access multimedia content (http://openstax.org/books/principles-finance/pages/14-video-activity)

1. Based on the scatter plot shown, will the correlation coefficient be a positive value or negative value? Would you estimate that the correlation is significant for the relationship between radio ads and revenue?
2. For the linear regression model for ads versus revenue, the slope is shown as 78.075. How would this slope be interpreted (that is, provide a verbal description for the meaning of the slope of 78.075)?

## How to Calculate Correlation for Stocks, Bonds, and Funds

Access multimedia content (http://openstax.org/books/principles-finance/pages/14-video-activity)

3. Based on the presentation shown in the video, is the FTSE 100 index correlated with the value of sterling? Or are the two measures uncorrelated? What data leads to your conclusion?

4. Based on the presentation in the video, is there a correlation between stock funds and bond funds? Why is this information important to an investor trying to design a portfolio?

15

# How to Think about Investing

**Figure 15.1** Investing can often provide great returns, but it can also be a risk. (credit: modification of work "E-ticker" by klip game/ Wikimedia Commons, Public Domain)

## Chapter Outline


**15.1** Risk and Return to an Individual Asset
**15.2** Risk and Return to Multiple Assets
**15.3** The Capital Asset Pricing Model (CAPM)
**15.4** Applications in Performance Measurement
**15.5** Using Excel to Make Investment Decisions


## Why It Matters

Having finished her college degree and embarked on her career, Maria is now contemplating her financial future. She is considering how she might invest some of her hard-earned money. As a short-term goal, she wants to build an emergency fund so that she could cover her expenses for six months if she became ill or injured and had to take time off of work. She would also like to save money for a down payment on a home and to purchase new furniture. Although she is not yet 30 years old, Maria also knows that it is prudent to begin saving for retirement.

What should she do with her savings? Maria has some friends who have told her how successful they have been investing in stocks. Bart bragged about doubling his money in just over a year when he purchased Facebook stock, and Tiffany quickly tripled her money when she purchased shares in Netflix. But Maria also knows that her uncle lost a significant amount of money when his Boeing stock dropped from over $300 per share to under $150 within a couple of months at the beginning of 2020. Just how risky would it be to invest in stocks? What type of return might Maria expect? Are there strategies she could follow that would allow her to avoid her uncle's fate?

# 15.1 Risk and Return to an Individual Asset

## Learning Outcomes

By the end of this section, you will be able to:

- Compute the realized return from an individual investment.
- Compute the average return and volatility of returns from historical data.
- Describe firm-specific risk.

## Measuring Historical Returns

*Risk* and *return* are often referred to as the two Rs of finance. Investors are interested in both risk and return because understanding one without the other is really meaningless. In terms of investment, the concept of *return* is fairly straightforward; return is the benefit, or profit, the investor expects from an expenditure. It is the reward for investing—the reason an investment is made in the first place. However, no investment is a sure thing. The return may not be what the investor was expecting. This uncertainty about what the return will be is referred to as *risk*.

We begin by looking at how to measure both risk and return when considering an individual asset, such as one stock. If your grandparents bought 100 shares of Apple, Inc. stock for you when you were born, you are interested in knowing how well that investment has done. You may even want to compare how that investment has fared to how an investment in a different stock, perhaps Disney, would have done. You are interested in measuring the historical return.

### Individual Investment Realized Return

The **realized return** of an investment is the total return that occurs over a particular time period. Suppose that you purchased a share of Target (TGT) at the beginning of January 2020 for $128.74. At the end of the year, you sold the stock for $176.53, which was $47.79 more than you paid for it. This increase in value is known as a *capital gain*. As the owner of the stock, you also received $2.68 in dividends during 2020. The *total dollar return* from your investment is calculated as

$$\begin{aligned}\text{Total Dollar Return} &= \text{Dividend Income} + \text{Capital Gain} \\ &= 2.68 + \$47.79 = \$50.47\end{aligned} \tag{15.1}$$

It is common to express investment returns in percentage terms rather than dollar terms. This allows you to answer the question “How much do I receive for each dollar invested?” so that you can compare investments of different sizes. The *total percent return* from your investment is

$$\begin{aligned}\text{Total Percent Return} &= \text{Dividend Yield} + \text{Capital Gain Yield} \\ &= \frac{\$2.68}{\$128.74} + \frac{\$47.79}{\$128.74} = 0.0208 + 0.3712 = 0.3920 = 39.20\%\end{aligned} \tag{15.2}$$

The **dividend yield** is calculated by dividing the dividends you received by the initial stock price. This calculation says that for each dollar invested in TGT in 2020, you received $0.0208 in dividends. The **capital gain yield** is the change in the stock price divided by the initial stock price. This calculation says that for each dollar invested in TGT in 2020, you received $0.3712 in capital gains. Your total percent return of 39.20% means that you made $0.392 for every dollar invested when your gains from both dividends and stock price appreciation are totaled together.

THINK IT THROUGH

Calculating Return

You purchased 10 shares of 3M (MMM) stock in January 2020 for $175 per share, received dividends of

$5.91 per share, and sold the stock at the end of the year for $169.72 per share. Calculate your total dollar return, your dividend yield, your capital gain yield, and your total percent yield.

**Solution:**

Because you purchased 10 shares, you received $\$5.91 \times 10 = \$59.10$ in dividend income. You spent $\$175.00 \times 10 = \$1{,}750.00$ to purchase the stock, and you sold it for $\$169.72 \times 10 = \$1{,}697.20$. Your total dollar return is

$$\begin{aligned}\text{Total Dollar Return} &= \text{Dividend Income} + \text{Capital Gain} \\ &= \$59.10 + (\$1{,}697.20 - \$1{,}750.00) = \$6.30\end{aligned} \tag{15.3}$$

Your dividend yield is $\frac{\$5.91}{\$175.00} = 0.0338$, or 3.38%, and your capital gain yield is $\frac{\$169.72 - \$175.00}{\$175.00} = -0.0302$, or 3.02%. Your total percent return is $3.38\% + (-3.02\%) = 0.36\%$.

Notice that you sold MMM for a price lower than what you paid for it at the beginning of the year. Your capital gain is negative, or what is often referred to as a *capital loss*. Although the price fell, you still had a positive total dollar return because of the dividend income.

Of course, investors seldom purchase a stock and then sell it exactly one year later. Assume that you purchased shares of Facebook (FB) on June 1, 2020, for $228.50 per share and sold the shares three months later for $261.90. You received no dividends. In this case, your **holding period percentage return** is calculated as

$$\frac{\$261.90 - \$228.50}{\$228.50} = 0.1462 = 14.62\% \tag{15.4}$$

This 14.62% is your return for a three-month holding period. To compare them to other investment opportunities, you need to express returns on a per-year, or *annualized*, basis. The holding period returned is converted to an **effective annual rate (EAR)** using the formula

$$\text{EAR} = (1 + \text{Holding Period Percentage Return})^m - 1 \tag{15.5}$$

where $m$ is the number of holding periods in a year.

There are four three-month periods in a year. So, the EAR for this investment is

$$\text{EAR} = (1 + 0.1462)^4 - 1 = 0.7260 = 72.60\% \tag{15.6}$$

What happens if you own a stock for more than one year? Your holding period return would have occurred over a period longer than a year, but the process to calculate the EAR is the same. Suppose you purchased shares of FB in May 2015, when it was selling for $79.30 per share. You held the stock until May 2020, when you sold it for $224.59. Your holding period percentage return would be $\frac{\$224.59 - \$79.30}{\$79.30} = 183.22\%$. You more than tripled your money, but it took you five years to do so. Your EAR, which will be smaller than this five-year holding period return rate, is calculated as

$$\text{EAR} = (1 + 1.8322)^{\frac{1}{5}} - 1 = 23.15\% \tag{15.7}$$

## Average Annual Returns

Suppose that you purchased shares of Delta Airlines (DAL) at the beginning of 2011 for $11.19 and held the stock for 10 years before selling it for $40.21. You made $\$40.21 - \$11.19 = \$29.02$ on your investment over a 10-year period. This is a 259.34% holding period return. The EAR for this investment is

$$\text{EAR} = (1 + 2.5934)^{\frac{1}{10}} - 1 = 13.65\% \quad \textbf{15.8}$$

To calculate the EAR using the above formula, the holding period return must first be calculated. The holding period return represents the percentage return earned over the entire time the investment is held. Then the holding period return is converted to an annual percentage rate using the formula.

You can also use the basic time value of money formula to calculate the EAR on an investment. In time value of money language, the initial price paid for the investment, $11.19, is the present value. The price the stock is sold for, $40.21, is the future value. It takes 10 years for the $11.19 to grow to $40.21. Using the time value of money will result in a calculation of

$$\begin{aligned} \text{PV} \times (1 + i)^n &= \text{FV} \\ 11.19 \times (1 + i)^{10} &= 40.21 \\ 1 + i &= 3.5934^{0.10} \\ i &= 13.65\% \end{aligned} \quad \textbf{15.9}$$

The EAR formula and the time value of money both result in a 13.65% annual return. Mathematically, the two formulas are the same; one is simply an algebraic rearrangement of the other.

If you earned 13.65% each year, compounded for 10 years, you would have converted your $11.19 per share investment to $40.21 per share. Of course, DAL stock did not increase by exactly 13.65% each year. The returns for DAL for each year are shown in Table 15.1. Some years, the return was much higher than 13.65%. In 2013, the return was almost 133%! Other years, the return was much lower than 13.65%; in fact, in the return was negative in four of the years.

| Year | Return | Value of Investment ($) |
|---|---|---|
| | | Initial investment of 11.19 |
| 2011 | −0.3579 | 7.19 |
| 2012 | 0.4672 | 10.54 |
| 2013 | 1.3261 | 24.52 |
| 2014 | 0.8053 | 44.27 |
| 2015 | 0.0405 | 46.06 |
| 2016 | −0.0135 | 45.44 |
| 2017 | 0.1623 | 52.81 |
| 2018 | −0.0866 | 48.24 |
| 2019 | 0.2038 | 58.07 |
| 2020 | −0.3077 | 40.20 |

**Table 15.1 Yearly Returns for DAL, 2011–2020: Value of Initial Investment at Each Year End**

Although an investment in DAL of $11.19 at the beginning of 2011 grew to $40.20 by the end of 2020, this growth was not consistent each year. The amount that the stock was worth at the end of each year is also shown in Table 15.1. During 2011, the return for DAL was −35.79%, resulting in the value of the investment falling to $\$11.19 \times [1 + (-0.3579)] = \$7.19$. The following year, 2012, the return for DAL was 46.72%. Therefore, the value of the investment was $\$7.19 \times 1 + (1 + 0.4672) = \$10.54$ at the end of 2012. This process continues each year that the stock is held.

The compounded annual return derived from the EAR and time value of money formulas is also known as a **geometric average return**. A geometric average return is calculated using the formula

$$\text{Geometric Average Return} = [(1 + R_1) \times (1 + R_2) \times \ldots \times (1 + R_N)]^{\frac{1}{N}} - 1 \quad \textbf{15.10}$$

where $R_N$ is the return for each year in the time period for which the average is calculated.

The calculation of the geometric average return for DAL is shown in the right column of Table 15.2. (The slight difference in the geometric average return of 13.64% from the 13.65% derived from the EAR and time value of money calculations is due to rounding errors.)

| Year | Return | 1 + Return | |
|---|---|---|---|
| 2011 | −0.3579 | 0.6421 | |
| 2012 | 0.4672 | 1.4672 | |
| 2013 | 1.3261 | 2.3261 | |
| 2014 | 0.8053 | 1.8053 | |
| 2015 | 0.0405 | 1.0405 | |
| 2016 | −0.0135 | 0.9865 | |
| 2017 | 0.1623 | 1.1623 | |
| 2018 | −0.0866 | 0.9134 | |
| 2019 | 0.2038 | 1.2038 | |
| 2020 | −0.3077 | 0.6923 | |
| **Arithmetic Avg** | **0.2240** | **3.5928** | **Product of (1 + Return)** |
| **Std Dev** | **0.5190** | **1.1364** | **Product raised to 1/N** |
| | | **0.1364** | **Geometric Average** |

**Table 15.2 Yearly Returns for DAL, 2011–2020, with Calculation of the Arithmetic Mean, Standard Deviation, and Geometric Mean**

Looking at Table 15.2, you will notice that the geometric average return differs from the mean return. Adding each of the annual returns and dividing the sum by 10 results in a 22.4% average annual return. This 22.4% is called the **arithmetic average return**.

The geometric average return will be smaller than the arithmetic average return (unless the returns for all years are identical). This is due to the basic arithmetic of compounding. Think of a very simple example in which you invest $100 for two years. If you have a positive return of 50% the first year and a negative 50% return the second year, you will have an arithmetic average return of $\frac{0.5 + (-0.50)}{2} = 0.0\%$, but you will have a geometric average return of $[(1 + 0.5) \times (1 - 0.5)]0.5 - 1 = -13.4\%$. With a 50% positive return the first year, you ended the year with $150. The second year, you lost 50% of that balance and were left with only $75.

Another important fact when studying average returns is that the order in which you earn the returns is not important. Consider what would have occurred if the returns in the two years were reversed, so that you faced a loss of 50% in the first year of your investment and a gain of 50% in the second year of your investment. With a −50% return in the first year, you would have ended that year with only $50. Then, if that $50 earned a positive 50% return the second year, you would have a $75 balance at the end of the two-year period. A negative return of 50% followed by a positive return of 50% still results in an arithmetic average return of 0% and a geometric average return of $[(1 - 0.5) \times (1 + 0.5)]0.5 - 1 = -13.4\%$.

## THINK IT THROUGH

### Calculating Arithmetic and Geometric Average Return

The annual returns for CVS Health Corp. (CVS) for the 10-year period of 2011–2020 are shown in Table 15.3.

| Year | Returns |
|---|---|
| 2011 | 18.94% |
| 2012 | 20.28% |
| 2013 | 50.38% |
| 2014 | 37.12% |
| 2015 | 2.90% |
| 2016 | −17.83% |
| 2017 | −5.75% |
| 2018 | −7.04% |
| 2019 | 17.26% |
| 2020 | −5.14% |

**Table 15.3 CVS Annual Returns, 2011–2020 (source: Yahoo! Finance)**

What was the arithmetic average return during the decade? What was the geometric average return during the decade?

**Solution:**

See Table 15.4 for the arithmetic mean and geometric mean calculations.

| | Arithmetic Average Calculation | Geometric Average Calculation | |
|---|---|---|---|
| **Year** | **Return** | **1 + Return** | |
| 2011 | 0.1894 | 1.1894 | |
| 2012 | 0.2028 | 1.2028 | |
| 2013 | 0.5038 | 1.5038 | |
| 2014 | 0.3712 | 1.3712 | |
| 2015 | 0.0290 | 1.0290 | |
| 2016 | −0.1783 | 0.8217 | |
| 2017 | −0.0575 | 0.9425 | |
| 2018 | −0.0704 | 0.9296 | |
| 2019 | 0.1726 | 1.1726 | |
| 2020 | −0.0514 | 0.9486 | |
| **Sum of Returns** | **1.1112** | **2.4309** | **Product of (1 + Return)** |

**Table 15.4 Yearly Returns for CVS, 2011–2020**

| | Arithmetic Average Calculation | Geometric Average Calculation | |
|---|---|---|---|
| Sum Divided by 10 | 0.1111 | 1.0929 | Raise Product to 1/10 |
| Arithmetic Average | 11.11% | 0.0929 | Subtract 1 |
| | | 9.29% | Geometric Average |

**Table 15.4 Yearly Returns for CVS, 2011–2020**

The arithmetic average return for CVS was 11.11%, and the geometric average return was 9.29%.

Both the arithmetic average return and the geometric average return are "correct" calculations. They simply answer different questions. The geometric average tells you what you actually earned per year on average, compounded annually. It is useful for calculating how much a particular investment grows over a period of time. The arithmetic average tells you what you earned in a typical year. When we are looking at the historical description of the distribution of returns and want to predict what to expect in a particular year, the arithmetic average is the relevant calculation.

## Measuring Risk

Although the arithmetic average return for Delta Airlines (DAL) for 2011–2020 was 22.4%, there is not a year in which the return was exactly 22.4%. In fact, in some years, the return was much higher than the average, such as in 2013, when it was 132.61%. In other years, the return was negative, such as 2011, when it was −35.79%. Looking at the yearly returns in Table 15.2, the return for DAL varies widely from year to year. In finance, this volatility of returns is considered risk.

### Volatility of Returns

The most commonly used measure of volatility of returns in finance is the standard deviation of the returns. The standard deviation of returns for DAL for the sample period 2011–2020 is 51.9%. Remember that if the normal distribution (a bell–shaped curve) describes returns, then 68% (or about two-thirds) of the time, the return in a particular year will be within one standard deviation above and one standard deviation below the arithmetic average return. Given DAL's average return of 22.4%, the actual yearly return will be somewhere between −29.5% and 74.29% in two out of three years. A very high return of greater than 74.29% would occur 16% of the time; a very large loss of more than 29.5% would also occur 16% of the time.

As you can see, there is a wide range of what can be considered a "typical" year for DAL. Although we can calculate an average return, the return in any particular year is likely to vary from that average. The larger the standard deviation, the greater this range of returns is. Thus, a larger standard deviation indicates a greater volatility of returns and, hence, more risk.

THINK IT THROUGH

#### Calculating the Standard Deviation of Returns

You calculated the arithmetic average return for CVS to be 11.11% for the 10-year period of 2011–2020. Calculate the standard deviation of returns for CVS for the same period (see Table 15.5). What does this tell you about what an investor in CVS experienced in a typical year during that decade?

**Solution:**

| Year | Return | Return – Mean | Squared Difference | |
|---|---|---|---|---|
| 2011 | 0.1894 | 0.0783 | 0.0061 | |
| 2012 | 0.2028 | 0.0917 | 0.0084 | |
| 2013 | 0.5038 | 0.3927 | 0.1542 | |
| 2014 | 0.3712 | 0.2601 | 0.0676 | |
| 2015 | 0.0290 | −0.0821 | 0.0067 | |
| 2016 | −0.1783 | −0.2894 | 0.0838 | |
| 2017 | −0.0575 | −0.1686 | 0.0284 | |
| 2018 | −0.0704 | −0.1815 | 0.0329 | |
| 2019 | 0.1726 | 0.0615 | 0.0038 | |
| 2020 | −0.0514 | −0.1625 | 0.0264 | |
| **Mean** | **0.1111** | | **0.4185** | **Sum of Squared Differences** |
| | | | **0.0465** | **Sum Divided by N – 1** |
| | | | **0.2156** | **Square Root** |

**Table 15.5 Standard Deviation of CVS Returns**

The standard deviation of returns for CVS during the sample period of 2011–2020 was 21.56%. With an arithmetic average return of 11.11%, the return would lie between −10.45% and 32.67% in about two out of three years. Even though the average return is 11.11%, a return in a particular year might be much higher or much lower than that average. In fact, a loss of more than 10.45% would be expected about once every six years. Also, about once every six years, a return greater than 32.67% would be expected.

## Firm-Specific Risk

Investors purchase a share of stock hoping that the stock will increase in value and they will receive a positive return. You can see, however, that even with well-established companies such as ExxonMobil and CVS, returns are highly volatile. Investors can never perfectly predict what the return on a stock will be, or even if it will be positive.

The yearly returns for four companies—Delta Airlines (DAL), Southwest Airlines (LUV), ExxonMobil (XOM), and CVS Health Corp. (CVS)—are shown in Table 15.6. Each of these stocks had years in which the performance was much better or much worse than the arithmetic average. In fact, none of the stocks appear to have a typical return that occurs year after year.

| | | Two-Stock Portfolio | | |
|---|---|---|---|---|
| Year | DAL | LUV | XOM | CVS |
| 2011 | −35.79% | −33.93% | 18.67% | 18.94% |
| 2012 | 46.72% | 20.03% | 4.70% | 20.28% |
| 2013 | 132.61% | 85.38% | 20.12% | 50.38% |
| 2014 | 80.53% | 126.47% | −6.06% | 37.12% |
| 2015 | 4.05% | 2.43% | −12.79% | 2.90% |
| 2016 | −1.35% | 16.72% | 19.88% | −17.83% |

**Table 15.6 Yearly Returns for DAL, LUV, XOM, and CVS (source: Yahoo! Finance)**

| | | Two-Stock Portfolio | | |
|---|---|---|---|---|
| Year | DAL | LUV | XOM | CVS |
| 2017 | 16.23% | 32.41% | −3.81% | −5.75% |
| 2018 | −8.66% | −28.28% | −15.09% | −7.04% |
| 2019 | 20.38% | 17.69% | 7.23% | 17.26% |
| 2020 | −30.77% | −13.04% | −36.21% | −5.14% |
| Average | 22.40% | 22.59% | −0.34% | 11.11% |
| Std Dev | 51.90% | 49.84% | 18.18% | 21.56% |

**Table 15.6 Yearly Returns for DAL, LUV, XOM, and CVS (source: Yahoo! Finance)**

Figure 15.2 contains a graph of the returns for each of these four stocks by year. In this graph, it is easy to see that DAL and LUV both have more volatility, or returns that vary more from year to year, than do XOM or CVS. This higher volatility leads to DAL and LUV having higher standard deviations of returns than XOM or CVS.

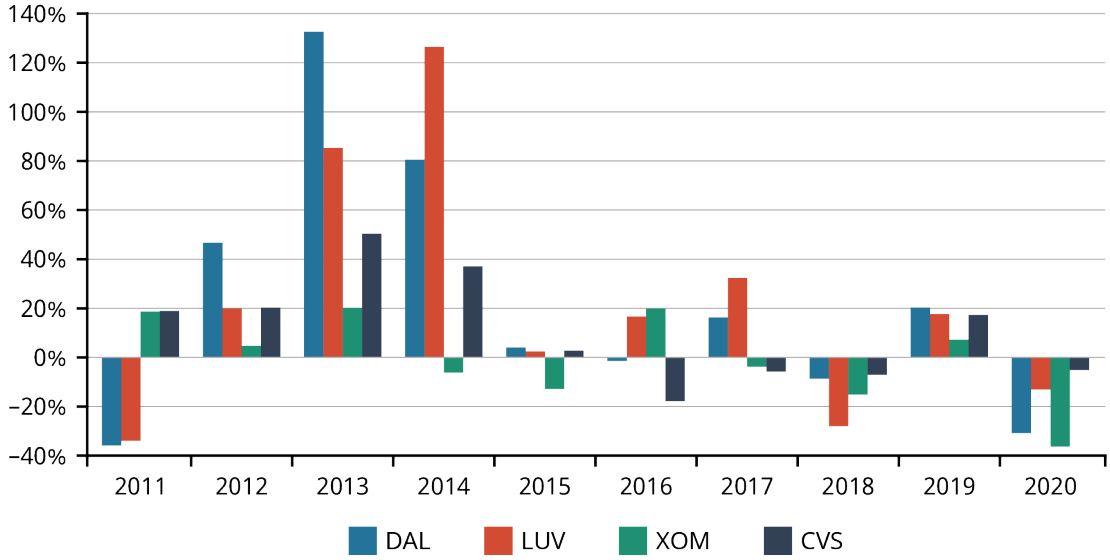



**Figure 15.2 Yearly Returns for DAL, LUV, XOM, and CVS** (data source: Yahoo! Finance)

Standard deviation is considered a measure of the risk of owning a stock. The larger the standard deviation of a stock's annual returns, the further from the average that stock's return is likely to be in any given year. In other words, the return for the stock is highly unpredictable. Although the return for CVS varies from year to year, it is not subject to the wide swings of the returns for DAL or LUV.

Why are stock returns so volatile? The value of the stock of a company changes as the expectations of the future revenues and expenses of the company change. These expectations may change due to a number of events and new information. Good news about a company will tend to result in an increase in the stock price. For example, DAL announcing that it will be opening new routes and flying to cities it has not previously serviced suggests that DAL will have more customers and more revenue in future years. Or if CVS announces that it has negotiated lower rent for many of its locations, investors will expect the expenses of the company to fall, leading to more profits. Those types of announcements will often be associated with a higher stock price. Conversely, if the pilots and flight attendants for DAL negotiate higher salaries, the expenses for DAL will increase, putting downward pressure on profits and the stock price.

LINK TO LEARNING

Peloton and Risk

An example of how news can impact the price of a stock occurred on May 5, 2021, when Peloton recalled all of its Tread+ and Tread products after the tragic death of a child and 70 injuries associated with use of its products.[1] The previous day, Peloton stock traded for $96.70 per share. The stock price dropped approximately 15% when the recall was announced. The closing price for a share of Peloton on May 5 was $82.62.[2] You can read the company's statement about this recall (https://openstax.org/r/the_companys_recall) online.

# 15.2 Risk and Return to Multiple Assets

## Learning Outcomes

By the end of this section, you will be able to:

- Explain the benefits of diversification.
- Describe the relationship between risk and return for large portfolios.
- Compare firm-specific and systematic risk.
- Discuss how portfolio size impacts risk.

## Diversification

So far, we have looked at the return and the volatility of an individual stock. Most investors, however, own shares of stock in multiple companies. This collection of stocks is known as a **portfolio**. Let's explore why it is wise for investors to hold a portfolio of stocks rather than to pick just one favorite stock to own.

We saw that investors who owned DAL experienced an average annual return of 20.87% but also a large standard deviation of 51.16%. Investors who used all their funds to purchase DAL stock did exceptionally well during 2012–2014. But in 2020, those investors lost almost one-third of their money as COVID-19 caused a sharp reduction in air travel worldwide. To protect against these extreme outcomes, investors practice what is called **diversification**, or owning a variety of stocks in their portfolios.

Suppose, for example, you have saved $50,000 that you want to invest. If you purchased $50,000 of DAL stock, you would not be diversified. Your return would depend solely on the return on DAL stock. If, instead, you used $5,000 to purchase DAL stock and used the remaining $45,000 to purchase nine other stocks, you would be diversifying. Your return would depend not only on DAL's return but also on the returns of the other nine stocks in your portfolio. Investors practice diversification to manage risk.

It is akin to the saying "Don't put all of your eggs in one basket." If you place all of your eggs in one basket and that basket breaks, all of your eggs will fall and crack. If you spread your eggs out across a number of baskets, it is unlikely that all of the baskets will break and all of your eggs will crack. One basket may break, and you will lose the eggs in that basket, but you will still have your other eggs. The same idea holds true for investing. If you own stock in a company that does poorly, perhaps even goes out of business, you will lose the money you placed in that particular investment. However, with a diversified portfolio, you do not lose all your money because your money is spread out across a number of different companies.

1 Trefis Team and Great Speculations. "Is Peloton's Tread+ Recall an Opportunity to Buy the Stock?" Forbes, May 7, 2021. https://www.forbes.com/sites/greatspeculations/2021/05/07/is-pelotons-tread-recall-an-opportunity-to-buy-the-stock/
2 Tomi Kilgore. "Peloton Stock Sinks to 8-Month Low after 125,000 Treadmills Recalled for 'Risk of Injury or Death.'" MarketWatch. May 6, 2021. https://www.marketwatch.com/story/peloton-stock-sinks-toward-9-month-low-after-125-000-treadmills-recalled-for-risk-of-injury-or-death-11620233715

## LINK TO LEARNING

### Diversification

Fidelity Investments Inc. is a multinational financial services firm and one of the largest asset managers in the world. In this educational video for investors (https://openstax.org/r/educational_investors), Fidelity provides an explanation of what diversification is and how it impacts an investor's portfolio.

Table 15.7 shows the returns of investors who placed 50% of their money in DAL and the remaining 50% in LUV, XOM, or CVS. Notice that the standard deviation of returns is lower for the two-stock portfolios than for DAL as an individual investment.

| Year | DAL | DAL and LUV | DAL and XOM | DAL and CVS |
|---|---|---|---|---|
| 2011 | −35.79% | −34.86% | −8.56% | −8.43% |
| 2012 | 46.72% | 33.38% | 25.71% | 33.50% |
| 2013 | 132.61% | 109.00% | 76.36% | 91.50% |
| 2014 | 80.53% | 103.50% | 37.24% | 58.83% |
| 2015 | 4.05% | 3.24% | −4.37% | 3.47% |
| 2016 | −1.35% | 7.69% | 9.27% | −9.59% |
| 2017 | 16.23% | 24.32% | 6.21% | 5.24% |
| 2018 | −8.66% | −18.47% | −11.88% | −7.85% |
| 2019 | 20.38% | 19.03% | 13.81% | 18.82% |
| 2020 | −30.77% | −21.90% | −33.49% | −17.95% |
| **Average** | **22.40%** | **22.49%** | **11.03%** | **16.75%** |
| **Std Dev** | **51.90%** | **49.11%** | **30.43%** | **35.10%** |

**Table 15.7 Yearly Returns for DAL Versus a Two-Stock Portfolio Containing DAL and LUV, XOM, or CVS** (data source: Yahoo! Finance)

As investors diversify their portfolios, the volatility of one particular stock becomes less important. XOM has good years with above-average returns and bad years with below-average (and even negative) returns, just like DAL. But the years in which those above-average and below-average returns occur are not always the same for the two companies. In 2014, for example, the return for DAL was greater than 80%, while the return for XOM was negative. On the other hand, in 2011, when DAL had a return of −35.15%, XOM had a positive return. When more than one stock is held, the gains in one stock can offset the losses in another stock, washing away some of the volatility.

When an investor holds only one stock, that one stock's volatility contributes 100% to the portfolio's volatility. When two stocks are held, the volatility of each stock contributes to the volatility of the portfolio. However, the volatility of the portfolio is not simply the average of the volatility of each stock held independently. How correlated the two stocks are, or how much they move together, will impact the volatility of the portfolio.

You will recall from our study of correlation in Regression Analysis in Finance that a correlation coefficient describes how two variables move relative to each other. A correlation coefficient of 1 means that there is a perfect, positive correlation between the two variables, while a correlation coefficient of −1 means that the two variables move exactly opposite of each other. Stocks that are in the same industry will tend to be more strongly correlated than stocks that are in much different industries. During the 2011–2020 time period, the correlation coefficient for DAL and LUV was 0.87, the correlation coefficient for DAL and XOM was 0.35, and the

correlation coefficient for DAL and CVS was 0.79. Combining stocks that are not perfectly positively correlated in a portfolio decreases risk.

Notice that investors who owned DAL and LUV from 2011 to 2020 would have had a lower portfolio standard deviation, but not much lower, than investors who just owned DAL. Because the correlation coefficient is less than one, the standard deviation fell. However, because the two stocks are in the same industry and exposed to many of the same economic issues, the correlation coefficient is relatively high, and combining those two stocks provides only a small decrease in risk.

This is because, as airlines, DAL and LUV face many of the same market conditions. In years when the economy is strong, the weather is good, fuel prices are low, and people are traveling a lot, both companies will do well. When something such as bad weather conditions reduces the amount of air travel for several weeks, both companies are harmed. By holding LUV in addition to DAL, investors can reduce exposure to risk that is specific to DAL (perhaps a problem that DAL has with its reservation system), but they do not reduce exposure to the risk associated with the airline industry (perhaps rising jet fuel prices). DAL and LUV tend to experience positive returns in the same years and negative returns in the same years.

On the other hand, investors who added XOM to their portfolio saw a significantly lower standard deviation than those who held just DAL. In years when jet fuel prices rise, harming the profits of both DAL and LUV, XOM is likely to see high profits. Diversifying a portfolio across firms that are less correlated will reduce the standard deviation of the portfolio more.

LINK TO LEARNING

How to Build a Diversified Portfolio

TV personality, former hedge fund manager, and author Jim Cramer encourages investors to build a diversified portfolio, having no more than 20% of a portfolio in one sector.[3] Watch this CNBC video (https://openstax.org/r/CNBC_video) to learn more about how he suggests investors can build a diversified portfolio by purchasing five to 10 stocks.

## Portfolio Size and Risk

As you add more stocks to a portfolio, the volatility, or standard deviation, of the portfolio decreases. The volatility of individual assets becomes less and less important. As we discussed earlier, the risk that is associated with events related to a particular company is called **firm-specific risk**, or unsystematic, risk. Examples of unsystematic risk would include a company facing a product liability lawsuit, a company inventing a new product, or accounting irregularities being detected. Holding a portfolio of stocks means that if one company you have invested in goes out of business because of poor management, you do not lose all your savings because some of your money is invested in other companies. Portfolio diversification protects you from being significantly impacted by unsystematic risk.

However, there is a level below which the portfolio risk does not drop, no matter how diversified the portfolio becomes. The risk that never goes away is known as **systematic risk**. Systematic risk is the risk of holding the market portfolio.

We have talked about reasons why a firm's returns might be volatile; for example, the firm discovering a new technology or having a product liability lawsuit brought against it will impact that firm specifically. There are also events that broadly impact the stock market. Changes in the Federal Reserve Bank's monetary policy and interest rates impact all companies. Geopolitical events, major storms, and pandemics can also impact the entire market. Investors in stocks cannot avoid this type of risk. This unavoidable risk is the systematic risk that

3 Abigail Stevenson. "Jim Cramer Shares His #1 Rule for Investing." Make It. CNBC, March 15, 2016. https://www.cnbc.com/2016/03/03/cramer-forget-sectors-a-better-way-to-diversify.html

investors in stocks have. This systematic risk cannot be eliminated through diversification.

In addition, as per research conducted by Meir Statman,[4] the standard deviation of a portfolio drops quickly as the number of stocks in the portfolio increases from one to two or three (see Figure 2 illustration in this subsequent article by Statman (https://openstax.org/r/subsequent_Statman) for context). Increasing the size of the portfolio decreases the standard deviation, and thus the risk, of the portfolio. However, as the portfolio increases in size, the amount of risk reduced by adding one more stock to the portfolio will decrease. How many stocks does an investor need for a portfolio to be well-diversified? There is not an exact number that all financial managers agree on. A portfolio of 15 highly correlated stocks will offer less benefits of diversification than a portfolio of 10 stocks with lower correlation coefficients. A portfolio that consists of American Airlines, Spirit Airlines, United Airlines, Southwest Airlines, Delta Airlines, and Jet Blue, along with a few other stocks, is not very diversified because of the heavy concentration in the airline industry. The term *diversified portfolio* is a relative concept, but the average investor can create a reasonably diversified portfolio with approximately a dozen stocks.

# 15.3 The Capital Asset Pricing Model (CAPM)

## Learning Outcomes

By the end of this section, you will be able to:

- Define risk premium.
- Explain the concept of beta.
- Compute the required return of a security using the CAPM.

## Risk-Free Rate

The **capital asset pricing model (CAPM)** is a financial theory based on the idea that investors who are willing to hold stocks that have higher systematic risk should be rewarded more for taking on this market risk. The CAPM focuses on systematic risk, rather than a stock's individual risk, because firm-specific risk can be eliminated through diversification.

Suppose that your grandparents have given you a gift of $20,000. After you graduate from college, you plan to work for a few years and then apply to law school. You want to use the $20,000 your grandparents gave you to pay for part of your law school tuition. It will be several years before you are ready to spend the money, and you want to keep the money safe. At the same time, you would like to invest the money and have it grow until you are ready to start law school.

Although you would like to earn a return on the money so that you have more than $20,000 by the time you start law school, your primary objective is to keep the money safe. You are looking for a risk-free investment. Lending money to the US government is considered the lowest-risk investment that you can make. You can purchase a US Treasury security. The chances of the US government not paying its debts is close to zero. Although, in theory, no investment is 100% risk-free, investing in US government securities is generally considered a risk-free investment because the risk is so miniscule.

The rate that you can earn by purchasing US Treasury securities is a proxy for the **risk-free rate**. It is used as an investing benchmark. The average rate of return for the three-month US Treasury security from 1928 to 2020 is 3.36%.[5] You can see that you will not become immensely wealthy by investing in US Treasury bills. Another characteristic of US Treasury securities, however, is that their volatility tends to be much lower than that of stocks. In fact, the standard deviation of returns for the US Treasury bills is 3.0%. Unlike the returns for stocks, the return on US Treasury bills has never been negative. The lowest annual return was 0.03%, which occurred in 2014.[6]

4 Meir Statman. "How Many Stocks Make a Diversified Portfolio?" Journal of Financial and Quantitative Analysis 22, no. 3 (September 1987): 353–363. https://doi.org/10.2307/2330969

LINK TO LEARNING

US Treasury Securities

Visit the website of the US Department of the Treasury (https://openstax.org/r/home.treasury) to learn more about US Treasury securities. You will find current interest rates for both short-term securities (US Treasury bills) and long-term securities (US Treasury bonds).

## Risk Premium

You know that if you use your $20,000 to invest in stock rather than in US Treasury bills, the outcome of the investment will be uncertain. Your investments may do well, but there is also a risk of losing money. You will only be willing to take on this risk if you are rewarded for doing so. In other words, you will only be willing to take the risk of investing in stocks if you think that doing so will make you more than you would make investing in US Treasury securities.

From 1928 to 2020, the average return for the S&P 500 stock index has been 11.64%, which is much higher than the 3.36% average return for US Treasury bills.[7] Stock returns, with a standard deviation of 19.49%, however, have also been much more volatile. In fact, there were 25 years in which the return for the S&P 500 index was negative.

You may not be willing to take the risk of losing some of the money your grandparents gave you because you have been setting it aside for law school. If that's the case, you will want to invest in US Treasury securities. You may have money that you are saving for other long-term goals, such as retirement, with which you are willing to take some risk. The extra return that you will earn for taking on risk is known as the **risk premium**. The risk premium can be thought of as your reward for being willing to bear risk.

The risk premium is calculated as the difference between the return you receive for taking on risk and what you would have returned if you did not take on risk. Using the average return of the S&P 500 (to measure what investors who bear the risk earn) and the US Treasury bill rate (to measure what investors who do not bear risk earn), the risk premium is calculated as

$$\begin{aligned}\text{Risk Premium} &= \text{S\&P 500 Avg Return} - \text{US T-Bill Avg Return} \\ &= 11.64\% - 3.36\% \;=\; 8.28\%\end{aligned} \tag{15.11}$$

## Beta

The risk premium represents how much an investor who takes on the market portfolio is rewarded for risk. Investors who purchase one stock—DAL, for example—experience volatility, which is measured by the standard deviation of that stock's returns. Remember that some of that volatility, the volatility caused by firm-specific risk, can be diversified away. Because investors can eliminate firm-specific risk through diversification, they will not be rewarded for that risk. Investors are rewarded for the amount of systematic risk they incur.

### Interpreting Beta

The relevant risk for investors is the systematic risk they incur. The systematic risk of a particular stock is measured by how much the stock moves with the market. The measure of how much a stock moves with the market is known as its **beta**. A stock that tends to move in sync with the market will have a beta of 1. For these stocks, if the market goes up 10%, the stock generally also goes up 10%; if the market goes down 5%, stocks with a beta of 1 also tend to go down 5%.

5 "Historical Return on Stocks, Bonds and Bills: 1928–2020." Damodaran Online. Stern School of Business, New York University, January 2021. http://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/histretSP.html
6 Ibid.
7 Ibid.

If a company has a beta greater than 1, then the stock tends to have a more pronounced move in the same direction as a market move. For example, if a stock has a beta of 2, the stock will tend to increase by 20% when the market goes up by 10%. If the market falls by 5%, that same stock will tend to fall by twice as much, or 10%. Thus, stocks with a beta greater than 1 experience greater swings than the overall market and are considered to be riskier than the average stock.

On the other hand, stocks with a beta less than 1 experience smaller swings than the overall market. A beta of 0.5, for example, means that a stock tends to experience moves that are only 50% of overall market moves. So, if the market increases by 10%, a stock with a beta of 0.5 would tend to rise by only 5%. A market decline of 5% would tend to be associated with a 2.5% decrease in the stock.

### Calculating Betas

The calculation of beta for DAL is demonstrated in Figure 15.3. Monthly returns for DAL and for the S&P 500 are plotted in the diagram. Each dot in the scatter plot corresponds to a month from 2018 to 2020; for example, the dot that lies furthest in the upper right-hand corner represents November 2020. The return for the S&P 500 was 10.88% that month; this return is plotted along the horizontal axis. The return for DAL during November 2020 was 31.36%; this return is plotted along the vertical axis.

You can see that generally, when the overall stock market as measured by the S&P 500 is positive, the return for DAL is also positive. Likewise, in months in which the return for the S&P 500 is negative, the return for DAL is also usually negative. Drawing a line that best fits the data, also known as a regression line, summarizes the relationship between the returns for DAL and the S&P 500. The slope of this line, 1.39, is DAL's beta. Beta measures the amount of systematic risk that DAL has.

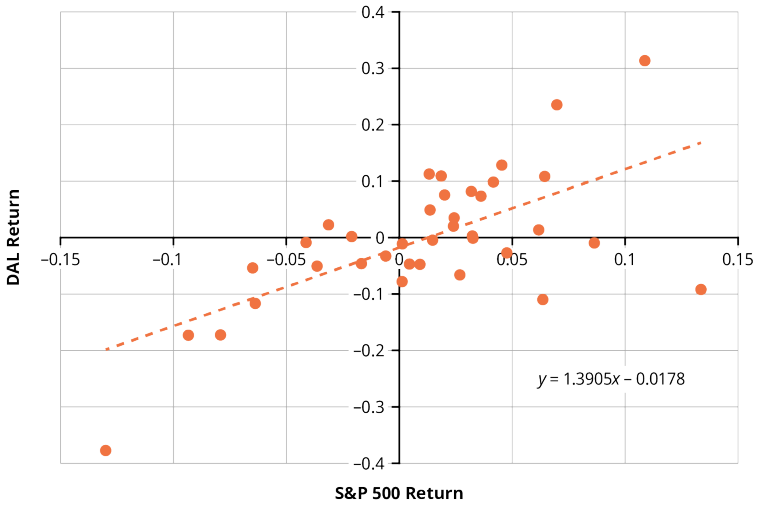



**Figure 15.3 Calculation of Beta for DAL** (data source: Yahoo! Finance)

## CAPM Equation

Because DAL's beta of 1.39 is greater than 1, DAL is riskier than the average stock in the market. Finance theory suggests that investors who purchase DAL will expect a higher rate of return to compensate them for this risk. DAL has 139% of the average stock's systematic risk; therefore, investors in the stock should receive 139% of the **market risk premium**.

The capital asset pricing model (CAPM) equation is

$$R_e = R_f + \text{Beta} \times \text{Market Risk Premium} \qquad \textbf{15.12}$$
$$R_e = R_f + \text{Beta} \times (R_m - R_f)$$

where $R_e$ is the expected return of the asset, $R_f$ is the risk-free rate of return, and $R_m$ is the expected return of the market. Given the average S&P 500 return of 11.64% and the average US Treasury bill return of 3.36%, the

expected return of DAL would be calculated as

$$R_e = R_{\text{US T–bill}} + \text{Beta} \times (R_{\text{S\&P}} - R_{\text{US T-bill}}) \quad \textbf{15.13}$$
$$R_e = 0.0336 + 1.39 \times (0.1164 - 0.0336) = 14.87\%$$

LINK TO LEARNING

### Calculating Beta

Many providers of stock data and investment information will list a company's beta. Two internet sources that can be used to find a company's beta are Yahoo! Finance (https://openstax.org/r/finance.yahoo) and MarketWatch (https://openstax.org/r/marketwatch_search). Various sources may not provide the exact same value for beta for a company. For example, in early February 2021, Yahoo! Finance reported that the beta for DAL was 1.46,[8] while MarketWatch reported it as 1.29.[9] Both of these numbers are slightly different from the 1.39 calculated in the graph above.

There are several reasons why beta may vary slightly from source to source. One is the time frame used in the beta calculation. Data from three years were used to calculate the beta in Figure 15.3. Time frames ranging from three to five years are commonly used when calculating beta. Another reason different sources might report different betas is the frequency with which the data is collected. Monthly returns are used in Figure 15.3; some analysts will use weekly data. Finally, the S&P 500 is used to measure the market return in Figure 15.3; the S&P 500 is one of the most common measures of overall market returns, but alternatives exist and are used by some analysts

LINK TO LEARNING

### CAPM

Watch this video (https://openstax.org/r/pricing-model-capm) for further information about the CAPM.

## 15.4 Applications in Performance Measurement

### Learning Outcomes

By the end of this section, you will be able to:

- Interpret a Sharpe ratio.
- Interpret a Treynor measurement.
- Interpret Jensen's alpha.

## Sharpe Ratio

Investors want a measure of how good a professional money manager is before they entrust their hard-earned funds to that professional for investing. Suppose that you see an advertisement in which McKinley Investment Management claims that the portfolios of its clients have an average return of 20% per year. You know that this average annual return is meaningless without also knowing something about the riskiness of the firm's strategy. In this section, we consider some ways to evaluate the riskiness of an investment strategy.

A basic measure of investment performance that includes an adjustment for risk is the **Sharpe ratio**. The **Sharpe ratio** is computed as a portfolio's risk premium divided by the standard deviation of the portfolio's return, using the formula

8 "Delta Air Lines, Inc. (DAL)." Yahoo! Finance. Verizon Media, accessed February 2021. https://finance.yahoo.com/quote/DAL/
9 "Delta Air Lines Inc." MarketWatch. Accessed February 2021. https://www.marketwatch.com/investing/stock/dal

$$\text{Sharpe Ratio} = \frac{R_P - R_f}{\sigma_P} \quad 15.14$$

The portfolio risk premium is the portfolio return $R_P$ minus the risk-free return $R_f$; this is the basic reward for bearing risk. If the risk-free return is 3%, McKinley Investment Management's clients who are earning 20% on their portfolios have an excess return of 17%.

The standard deviation of the portfolio's return, $\sigma_P$, is a measure of risk. Although you see that McKinley's clients earn a nice 20% return on average, you find that the returns are highly volatile. In some years, the clients earn much more than 20%, and in other years, the return is much lower, even negative. That volatility leads to a standard deviation of returns of 26%. The Sharpe ratio would be $\frac{17\%}{26\%}$, or 0.65.

Thus, the Sharpe ratio can be thought of as a reward-to-risk ratio. The standard deviation in the denominator can be thought of as the units of risk the investor has. The numerator is the reward the investor is receiving for taking on that risk.

LINK TO LEARNING

Sharpe Ratio

The Sharpe ratio was developed by Nobel laureate William F. Sharpe. You can visit Sharpe's Stanford University website (https://openstax.org/r/stanford_wfsharpe) to find videos in which he discusses financial topics and links to his research as well as his advice on how to invest.

## Treynor Measurement of Performance

Another reward-to-risk ratio measurement of investment performance is the **Treynor ratio**. The Treynor ratio is calculated as

$$\text{Treynor Ratio} = \frac{R_P - R_f}{\beta_P} \quad 15.15$$

Just as with the Sharpe ratio, the numerator of the Treynor ratio is a portfolio's risk premium; the difference is that the Treynor ratio focus focuses on systematic risk, using the beta of the portfolio in the denominator, while the Shape ratio focuses on total risk, using the standard deviation of the portfolio's returns in the denominator.

If McKinley Investment Management has a portfolio with a 20% return over the past five years, with a beta of 1.2 and a risk-free rate of 3%, the Treynor ratio would be $\frac{(0.20 - 0.03)}{1.2} = 0.14$.

Both the Sharpe and Treynor ratios are relative measures of investment performance, meaning that there is not an absolute number that indicates whether an investment performance is good or bad. An investment manager's performance must be considered in relation to that of other managers or to a benchmark index.

## Jensen's Alpha

**Jensen's alpha** is another common measure of investment performance. It is computed as the raw portfolio return minus the expected portfolio return predicted by the CAPM:

$$\begin{aligned} \text{Jensen's Alpha} = \alpha_P &= R_P - R_e \\ &= R_P - [R_f + \beta_P(R_m - R_f)] \end{aligned} \quad 15.16$$

Suppose that the average market return has been 12%. What would Jensen's alpha be for McKinley Investment Management's portfolio with a 20% average return and a beta of 1.2?

$$\alpha_{\text{McKinley}} = 0.2 - [0.03 + 1.2(0.12 - 0.03)] = 0.062 \quad 15.17$$

Unlike the Sharpe and Treynor ratios, which are meaningful in a relative sense, Jensen's alpha is meaningful in an absolute sense. An alpha of 0.062 indicates that the McKinley Investment Management portfolio provided a return that was 6.2% higher than would be expected given the riskiness of the portfolio. A positive alpha indicates that the portfolio had an abnormal return. If Jensen's alpha equals zero, the portfolio return was exactly what was expected given the riskiness of the portfolio as measured by beta.

THINK IT THROUGH

### Comparing the Returns and Risks of Portfolios

You are interviewing two investment managers. Mr. Wong shows that the average return on his portfolio for the past 10 years has been 14%, with a standard deviation of 8% and a beta of 1.2. Ms. Petrov shows that the average return on her portfolio for the past 10 years has been 16%, with a standard deviation of 10% and a beta of 1.6. You know that over the past 10 years, the US Treasury security rate has averaged 2% and the return on the S&P 500 has averaged 11%. Which portfolio manager do you think has done the better job?

**Solution:**

The Sharpe ratio for Mr. Wong's portfolio is $\frac{14\% - 2\%}{8\%} = 1.5$, and the Treynor ratio is $\frac{14\% - 2\%}{1.2} = 10$. The Sharpe ratio for Ms. Petrov's portfolio is $\frac{16\% - 2\%}{10\%} = 1.4$, and the Treynor ratio is $\frac{16\% - 2\%}{1.6} = 8.75$.

Jensen's alpha for Mr. Wong's portfolio is

$$\alpha_{\text{Wong}} = 0.14 - [0.02 + 1.2(0.11 - 0.02)] = 0.012 \quad \textbf{15.18}$$

Jensen's alpha for Ms. Petrov's portfolio is

$$\alpha_{\text{Petrov}} = 0.16 - [0.02 + 1.6(0.11 - 0.02)] = -0.004 \quad \textbf{15.19}$$

All three measures of portfolio performance suggest that Mr. Wong's portfolio has performed better than Ms. Petrov's has. Although Ms. Petrov has had a larger average return, the portfolio she manages is riskier. Ms. Petrov's portfolio is more volatile than Mr. Wong's, resulting in a higher standard deviation. Ms. Petrov's portfolio has a higher beta, which means it has a higher amount of systematic risk. The CAPM suggests that a portfolio with a beta of 1.6 should have an expected return of 16.4%. Because Ms. Petrov's portfolio has an average return of less than that, investors in Ms. Petrov's portfolio are not rewarded for the risk that they have taken as much as would be expected.

## 15.5 Using Excel to Make Investment Decisions

### Learning Outcomes

By the end of this section, you will be able to:

- Calculate the average return and standard deviation for a stock.
- Calculate the average return and standard deviation for a portfolio.
- Calculate the beta of a stock.

### Average Return and Standard Deviation for a Single Stock

Excel can be used to calculate the average returns and the standard deviation of returns for both a single stock and a portfolio of stocks. It can also be used to calculate the beta for a stock. Historic stock price data for stocks you are interested in analyzing can easily be downloaded from sites such as Yahoo! Finance into Excel. The examples in this section use monthly stock data from December 2017 to December 2020 from Yahoo! Finance.

Monthly price data for AMZN (Amazon) is shown in column B of Figure 15.4. To begin, monthly returns must be calculated from the price data using the formula

$$\text{Monthly Return} = \frac{\text{Ending Price} - \text{Beginning Price}}{\text{Beginning Price}} \quad \textbf{15.20}$$

The ending prices shown in Figure 15.4 are the last price the stock traded for each month. Each month, the return is calculated under the assumption that you purchased the stock at the last trading price of the previous month and sold at the last price of the current month. Thus, the return for January 2018 is calculated as

$$\text{Monthly Return} = \frac{\text{Jan 2018 Price} - \text{Dec 2017 Price}}{\text{Dec 2017 Price}} = \frac{\$1{,}450.89 - \$1{,}169.47}{\$1{,}169.47} = 0.2406 = 24.06\% \quad \textbf{15.21}$$

This is accomplished in Excel by placing the formula =(B3-B2)/B2 in cell C3. This formula can then be copied down the spreadsheet through row C38. Now that each monthly return is in column C, you can calculate the average of the monthly returns in cell C39 and the standard deviation of returns in cell C40.

| | A | B | C | D |
|---|---|---|---|---|
| 1 | **Date** | **Ending Price** | **Monthly Return** | |
| 2 | 12/1/2017 | 1169.4700 | | |
| 3 | 1/1/2018 | 1450.8900 | 0.2406 | |
| 4 | 2/1/2018 | 1512.4500 | 0.0424 | |
| 29 | 3/1/2020 | 1949.7200 | 0.0350 | |
| 30 | 4/1/2020 | 2474.0000 | 0.2689 | |
| 31 | 5/1/2020 | 2442.3701 | -0.0128 | |
| 32 | 6/1/2020 | 2758.8201 | 0.1296 | |
| 33 | 7/1/2020 | 3164.6799 | 0.1471 | |
| 34 | 8/1/2020 | 3450.9600 | 0.0905 | |
| 35 | 9/1/2020 | 3148.7300 | -0.0876 | |
| 36 | 10/1/2020 | 3036.1499 | -0.0358 | |
| 37 | 11/1/2020 | 3168.0400 | 0.0434 | |
| 38 | 12/1/2020 | 3256.9299 | 0.0281 | |
| 39 | | Average Monthly Return | 0.0330 | |
| 40 | | Standard Deviation | 0.0933 | |

**Figure 15.4 Calculating the Average Return and the Standard Deviation of Returns for AMZN** (data source: Yahoo! Finance)

Over the three-year period, the average monthly return for AMZN was 3.3%. However, this return was highly volatile, with a standard deviation of 9.33%. Remember that this means that approximately two-thirds of the time, the monthly return from AMZN was between −6.03% and 12.63%.

*Download the spreadsheet file (https://openstax.org/r/google_spread_sheet) containing key Chapter 15 Excel exhibits.*

## Average Return and Standard Deviation for a Portfolio

The Excel screenshot in Figure 15.5 shows the return and standard deviation calculation for a portfolio. This sample four-stock portfolio contains AMZN, CVS, AAPL (Apple), and NFLX (Netflix). This portfolio is constructed as an equally weighted portfolio; because there are four stocks in this portfolio, each has a weight of 25%.

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | Weights | 0.25 | 0.25 | 0.25 | 0.25 | |
| 2 | **Date** | **AMZN** | **CVS** | **AAPL** | **NFLX** | **Portfolio Return** |
| 3 | 1/1/2018 | 0.2406 | 0.0854 | -0.0106 | 0.4081 | **0.1809** |
| 4 | 2/1/2018 | 0.0424 | -0.1393 | 0.0638 | 0.0780 | **0.0112** |
| 5 | 3/1/2018 | -0.0430 | -0.0815 | -0.0542 | 0.0136 | **-0.0413** |
| 6 | 4/1/2018 | 0.0821 | 0.1225 | -0.0150 | 0.0579 | **0.0619** |
| 27 | 1/1/2020 | 0.0871 | -0.0871 | 0.0540 | 0.0665 | **0.0301** |
| 28 | 2/1/2020 | -0.0622 | -0.1274 | -0.1168 | 0.0694 | **-0.0593** |
| 29 | 3/1/2020 | 0.0350 | 0.0025 | -0.0676 | 0.0175 | **-0.0031** |
| 30 | 4/1/2020 | 0.2689 | 0.0374 | 0.1554 | 0.1181 | **0.1450** |
| 31 | 5/1/2020 | -0.0128 | 0.0653 | 0.0822 | -0.0003 | **0.0336** |
| 32 | 6/1/2020 | 0.1296 | -0.0092 | 0.1505 | 0.0841 | **0.0888** |
| 33 | 7/1/2020 | 0.1471 | -0.0312 | 0.1651 | 0.0744 | **0.0888** |
| 34 | 8/1/2020 | 0.0905 | -0.0130 | 0.2144 | 0.0832 | **0.0938** |
| 35 | 9/1/2020 | -0.0876 | -0.0599 | -0.1009 | -0.0558 | **-0.0760** |
| 36 | 10/1/2020 | -0.0358 | -0.0396 | -0.0600 | -0.0486 | **-0.0460** |
| 37 | 11/1/2020 | 0.0434 | 0.2086 | 0.0936 | 0.0314 | **0.0943** |
| 38 | 12/1/2020 | 0.0281 | 0.0075 | 0.1165 | 0.1020 | **0.0635** |
| 39 | Monthly Avg Ret | 0.0330 | 0.0021 | 0.0380 | 0.0347 | **0.0269** |
| 40 | Std Dev | 0.0920 | 0.0863 | 0.0967 | 0.1087 | **0.0710** |

**Figure 15.5 Calculation of the Average Return and Standard Deviation for a Portfolio** (data source: Yahoo! Finance)

The monthly returns for each stock are recorded in their respective columns. The portfolio return for each month is calculated as the weighted average of the four monthly individual stock returns. The formula for the portfolio return is

$$\text{Portfolio Return} = 0.25 \times R_{\text{AMZN}} + 0.25 \times R_{\text{CVS}} + 0.25 \times R_{\text{AAPL}} + 0.25 \times R_{\text{NFLX}} \quad \textbf{15.22}$$

The formula =$B$1*B3+$C$1*C3+$D$1*D3+$E$1*E3 is placed in cell F3. The formula is then copied down column F to calculate the portfolio return for each month. After the monthly portfolio return is calculated, then the average monthly portfolio return is calculated in cell F39. The average monthly portfolio return is 2.69%.

Because this is an equally weighted portfolio, with each of the four stocks impacting the portfolio return in the same way, the average monthly portfolio return of 2.69% is the same as the sum of the average monthly returns of the four stocks divided by four, or $\frac{0.0330 + 0.0021 + 0.0380 + 0.0347}{4} = 0.0269 = 2.69\%$.

The standard deviation of the monthly portfolio returns is calculated in cell F40. This four-stock portfolio has a standard deviation of 7.10%. Unlike the average return, this standard deviation is not equal to the average of the standard deviations of returns of the four stocks. In fact, the standard deviation for the portfolio is less than the standard deviation for any one of the four stocks. Remember that this occurs because the stock returns are not perfectly positively correlated. The high return of one of the stocks in one month is dampened by a lower return in another stock during the same month. Likewise, a negative return in one stock during a month might be offset by a positive return in one of the other three stocks during the same month. This is the risk reduction benefit of holding a portfolio of stocks.

## Calculating Beta

The standard deviation of a stock's returns indicates the stock's volatility. Remember that the volatility is caused by both firm-specific and systematic risk. Investors will not be rewarded for firm-specific risk because

they can diversify away from it. Investors are, however, rewarded for systematic risk. To determine how much of a firm's risk is due to systematic risk, you can use Excel to calculate the stock's beta.

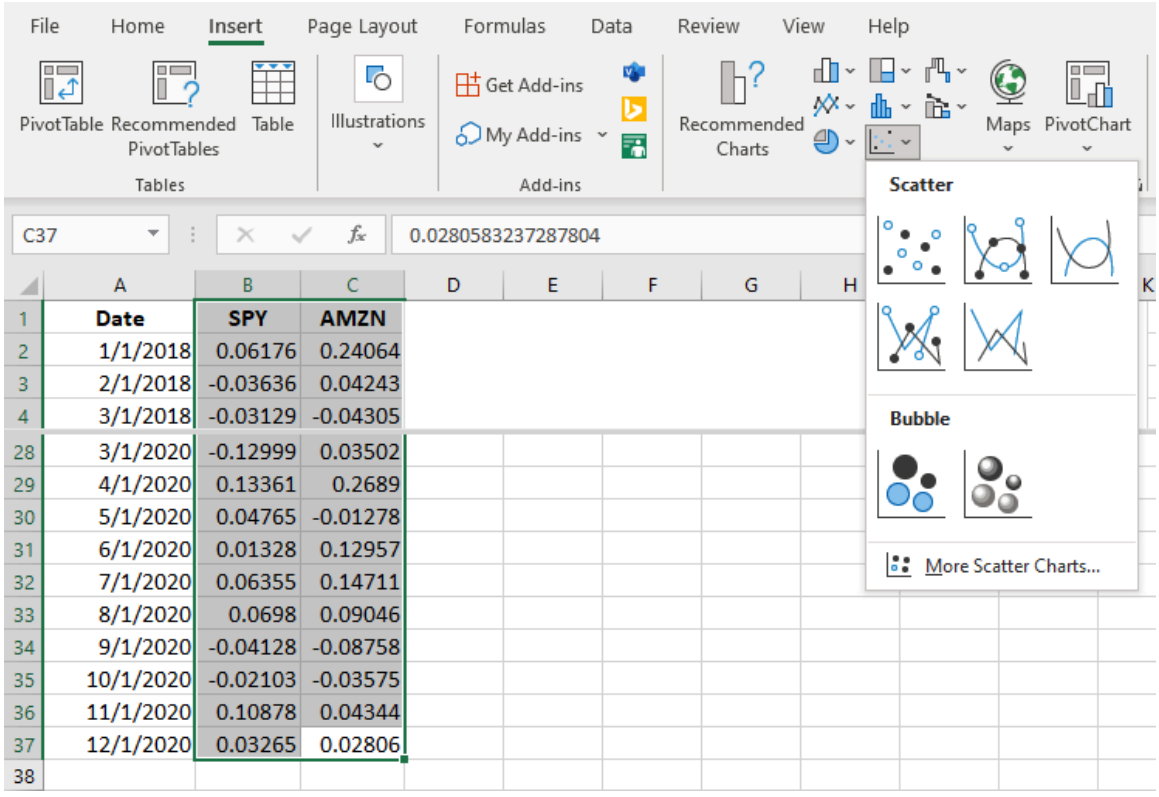
To calculate a stock's beta, you need the monthly return for the market in addition to the monthly market return for the stock. In column B in Figure 15.6, the monthly return for SPY, the SPDR S&P 500 Trust, is recorded. SPY is an ETF that was created to mimic the performance of the S&P 500 index by State Street Global Advisors and is often used as a proxy for the overall market performance. The monthly returns for AMZN are visible in column C. It is important that these returns be lined up so that the returns for a particular month for both securities appear in the same row number. Also, you want to place the returns for SPY in the column to the left of the returns for AMZN so that when you create your graph, SPY will automatically appear on the horizontal axis.

### LINK TO LEARNING

#### State Street Global Advisors

You can learn more about State Street Global Advisors and its creation of the first ETF by visiting the company's history page at its website (ssga.com) (https://openstax.org/r/ssga_institutional_our-history).

You will use a scatter plot to create a graph. In Excel, go to the Insert tab, and then from the Chart menu, choose the first scatter plot option.




| | A | B | C |
|---|---|---|---|
| 1 | Date | SPY | AMZN |
| 2 | 1/1/2018 | 0.06176 | 0.24064 |
| 3 | 2/1/2018 | -0.03636 | 0.04243 |
| 4 | 3/1/2018 | -0.03129 | -0.04305 |
| 28 | 3/1/2020 | -0.12999 | 0.03502 |
| 29 | 4/1/2020 | 0.13361 | 0.2689 |
| 30 | 5/1/2020 | 0.04765 | -0.01278 |
| 31 | 6/1/2020 | 0.01328 | 0.12957 |
| 32 | 7/1/2020 | 0.06355 | 0.14711 |
| 33 | 8/1/2020 | 0.0698 | 0.09046 |
| 34 | 9/1/2020 | -0.04128 | -0.08758 |
| 35 | 10/1/2020 | -0.02103 | -0.03575 |
| 36 | 11/1/2020 | 0.10878 | 0.04344 |
| 37 | 12/1/2020 | 0.03265 | 0.02806 |
| 38 | | | |

**Figure 15.6 Excel Format for Calculating Beta** (data source: Yahoo! Finance)

Selecting the scatter plot option will result in a chart being inserted that looks like the chart in Figure 15.7. Each dot represents one month's combination of returns, with the return for SPY measured on the horizontal axis and the return for AMZN measured on the vertical axis. Consider, for example, the dot in the furthest upper right-hand section of the figure. This dot is the plot of returns for the month of April 2020, when the return for SPY was 13.36% (measured on the horizontal axis) and the return for AMZN was 26.89% (measured

on the vertical axis).

Hover your mouse over one of the dots, and right-click the dot to pull up a chart formatting menu. This menu will allow you to add labels to your axis and polish your chart in additional ways if you would like. Select the option Add Trendline.

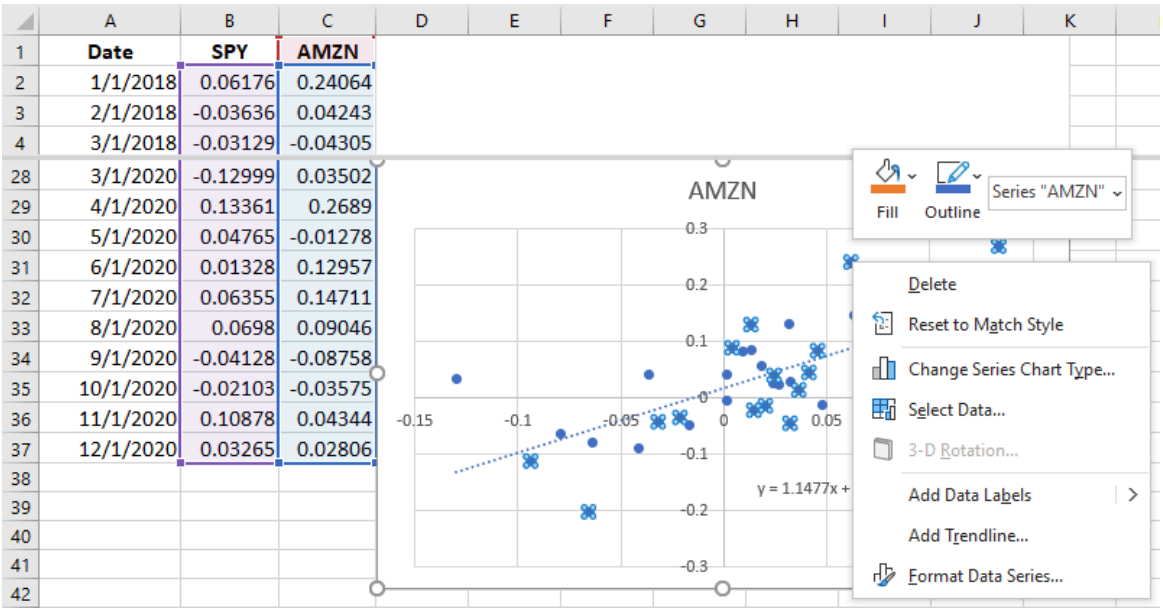



**Figure 15.7 Creating a Scatter Plot in Excel** (data source: Yahoo! Finance)

When the trendline is inserted, a formatting box will appear on the right of your screen (see Figure 15.8). If it is not already selected, choose the Linear trendline option. Scroll down and select the "Display Equation on chart" option. You will see the equation $y = 1.1477x + 0.0186$ appear on the screen. This is the equation for the best-fit line that shows how AMZN moves when the market moves. The slope of this line, 1.1477, is the beta for AMZN. This tells you that for every 10% move the overall market makes, AMZN tends to move 11.477%. Because AMZN tends to move a little more than the broader market, it has a little more systematic risk than the average stock in the market.

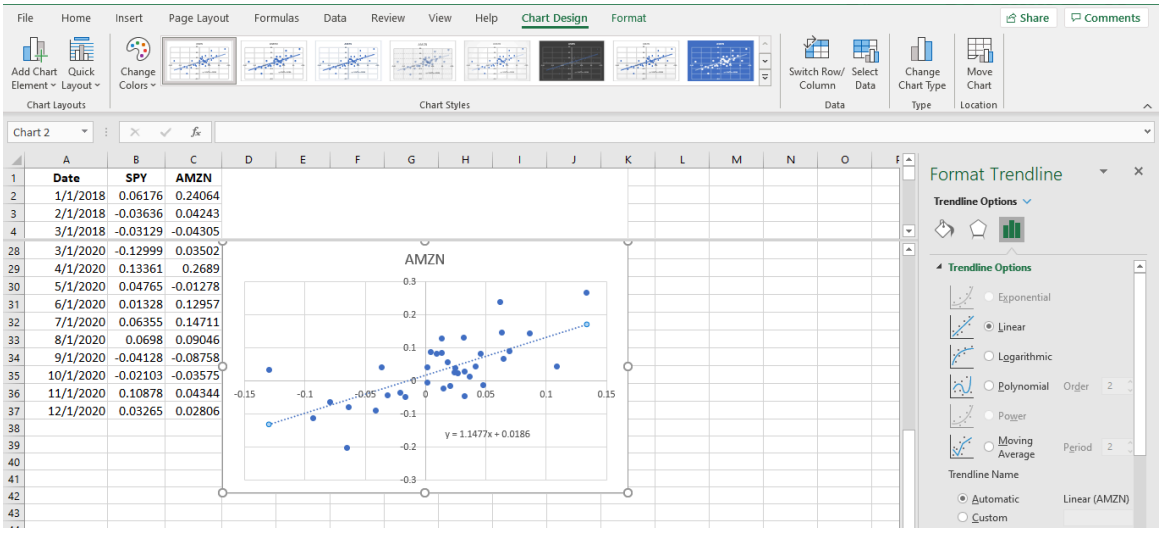



**Figure 15.8 Inserting a Trendline to Determine Beta** (data source: Yahoo! Finance)

# Summary

## 15.1 Risk and Return to an Individual Asset

Investors are interested in both the return they can expect to receive when making an investment and the risk associated with that investment. In finance, risk is considered the volatility of the return from time period to time period. Historical returns are measured by the arithmetic average, and the risk is measured by the standard deviation of returns.

## 15.2 Risk and Return to Multiple Assets

As investors hold multiple assets in a portfolio, they are able to eliminate firm-specific risk. However, systematic or market risk remains, even if an investor holds the market portfolio. The return to a portfolio is measured by the arithmetic average, and the risk is measured by the standard deviation of the returns of the portfolio. The risk of the portfolio will be lower than the weighted average of the risk of the individual securities because the returns of the securities are not perfectly correlated. A low or negative return for one stock in a period can be offset by a high return for another stock in the same period.

## 15.3 The Capital Asset Pricing Model (CAPM)

The capital asset pricing model (CAPM) relates the expected return of an asset to the systematic risk of that asset. Investors will be rewarded for taking on systematic risk. They will not be rewarded for taking on firm-specific risk, however, because that risk can be diversified away.

## 15.4 Applications in Performance Measurement

Because investors are not simply interested in returns but are also interested in risk, the success of a portfolio cannot be measured simply by considering the portfolio's return. In order to compare investment portfolios, risk and return must both be taken into consideration. The Sharpe ratio and the Treynor ratio are two measures that provide a reward-to-risk measure of a portfolio. Jensen's alpha provides a measure of the abnormal return of a portfolio, considering the portfolio's risk level.

## 15.5 Using Excel to Make Investment Decisions

Using Excel to manipulate publicly available stock data makes calculating the average return of a stock and the standard deviation of returns easy. The average return for a portfolio and the standard deviation of the portfolio returns can also be calculated easily. By comparing the returns of a stock with the returns of the overall market using Excel charting tools, the beta for a stock, which measures systematic risk, can be determined.

# Key Terms

**arithmetic average return** the sum of an asset's annual returns over a number of years divided by the number of years

**beta** a measure of how a stock moves relative to the market

**capital asset pricing model (CAPM)** the expected return of a security, equal to the risk-free rate plus a premium for the amount of risk taken

**capital gain yield** the difference between the price a stock is sold for and the price that was originally paid for it divided by the price originally paid

**diversification** holding a variety of assets in a portfolio

**dividend yield** the total dividends received by the owner of a share of stock divided by the price originally paid for the stock

**effective annual rate (EAR)** returns expressed on an annualized or yearly basis; allows for the comparison of various investments

**firm-specific risk** the risk that an event may impact the expected revenue or costs of a firm, thereby

impacting the returns to investors; also known as diversifiable risk

**geometric average return** the compound annual return derived from the effective annual rate and time value of money formulas

**holding period percentage return** the gain received from holding a stock, calculated by adding the amount received when the stock is sold to any dividends earned while holding the stock, subtracting the price originally paid for the stock, then dividing the difference by the price originally paid

**Jensen's alpha** a measure of portfolio performance, calculated as the raw portfolio return minus the expected portfolio return predicted by the CAPM

**market risk premium** the reward for taking on the average amount of market risk

**portfolio** a collection of owned stocks

**realized return** the total return of an investment that occurs over a particular time period

**risk premium** the extra return earned by taking on risk

**risk-free rate** the reward for lending money when there is no risk of not receiving the principal and interest as promised

**Sharpe ratio** a reward-to-risk measure of portfolio performance, calculated by subtracting the risk-free rate from the average portfolio return and then dividing by the standard deviation of the portfolio

**systematic risk** risk that impacts the entire market and cannot be diversified away; also known as market risk

**Treynor ratio** a reward-to-risk measure of portfolio performance, calculated by subtracting the risk-free rate from the average portfolio return and then dividing by the beta of the portfolio

## CFA Institute

This chapter supports some of the Learning Outcome Statements (LOS) in this CFA® Level I Study Session (https://openstax.org/r/cfa-inst-study-session). Reference with permission of CFA Institute.

## Multiple Choice

1. The total dollar return equals _____.
   a. the EPS of a stock
   b. capital gains income plus dividend income
   c. the price paid for a share of stock minus the selling price of the stock
   d. the price paid for a share of stock divided by the selling price of the stock

2. The dividend yield is calculated by _____.
   a. dividing the price of the stock by the EPS
   b. subtracting any capital loss from the capital gain
   c. dividing the annual dividend by the initial stock price
   d. dividing the annual dividend by the net income for the year

3. Which of the following is the best example of firm-specific risk?
   a. A global pandemic causes major disruptions in the economy.
   b. The Federal Reserve increases the money supply dramatically, leading to massive inflation.
   c. AAA Pharmaceuticals withdraws a medication as it studies whether strokes five people suffered after taking the medication were related to the medication.
   d. As an arctic blast descends on North America, most of the United States is blanketed in snow or ice.

4. Investors diversify their portfolio in order to _____.
   a. reduce risk
   b. increase risk
   c. increase return
   d. increase the standard deviation

5. Which of the following would be the best example of systematic risk?
   a. An error in the company's computer system miscalculates the amount of inventory that Monique's Boutique is holding.
   b. BlueJay Air has a reduction in new reservations following a crash of one of its jets.
   c. The spokesperson for Serena's Sports Shoes is involved in an ethical scandal.
   d. Interest rates rise after the Federal Reserve announces it will slow down the rate of growth of the money supply.

6. As the number of stocks in a portfolio increases, _____.
   a. firm-specific risk increases
   b. systematic risk becomes zero
   c. systematic risk decreases and returns increase
   d. firm-specific risk is reduced but systematic risk remains

7. Beta is a measure of _____.
   a. systematic risk
   b. firm-specific risk
   c. a firm's profitability
   d. a stock's dividend yield

8. Which of the following would be the best estimate of the risk-free rate?
   a. The rate of inflation
   b. The average return on the S&P 500
   c. The average return on Amazon's stock
   d. The average return on US Treasury bills

9. The Sharpe ratio can be considered a measure of _____.
   a. the reward of an investment in relation to the risk
   b. the systematic risk of a stock
   c. the total return of a stock investment
   d. the historical return of an individual security

10. A positive Jensen's alpha indicates that a portfolio has _____.
    a. a negative beta
    b. an abnormal return
    c. more total risk than the average portfolio
    d. more systematic risk than the average portfolio

11. If an equally weighted portfolio contains 10 stocks, then _____.
    a. the stocks in the portfolio will each have a weight of 0.10
    b. the return of the portfolio must be multiplied by 10 to get the annualized return
    c. the standard deviation of the portfolio will be one-tenth the standard deviation of one of the stocks
    d. the standard deviation of the portfolio will be 10 times the standard deviation of one of the stocks

## Review Questions

1. What is the difference between firm-specific risk and unsystematic risk?

2. Explain why diversification reduces unsystematic risk but not systematic risk.

3. Explain what happens to the standard deviation of returns of a portfolio as the number of stocks in the portfolio increases.

4. Enrique owns five stocks: Alaska Airlines, American Airlines, Delta Airlines, Southwest Airlines, and Ford. Radha also owns five stocks: Apple, McDonald's, Tesla, Facebook, and Disney. Does Enrique or Radha have

a more diversified portfolio?

5. You are considering purchasing shares in a company that has a beta of 0.8. Explain what this beta means.
6. Explain how the Sharpe ratio and the Treynor ratio can be considered reward-to-risk measures.

## Problems

1. You purchase 100 shares of COST (Costco) for $280 per share. Three months later, you sell the stock for $290 per share. You receive a dividend of $0.57 a share. What is your total dollar return?
2. You purchase 100 shares of COST for $280 per share. Three months later, you sell the stock for $290 per share. You receive a dividend of $0.57 a share. What are your dividend yield, capital gain yield, and total percentage return?
3. You purchase 100 shares of COST for $280 per share. Three months later, you sell the stock for $290 per share. You receive a dividend of $0.57 a share. What is the EAR of your investment?
4. You invest in a stock for four years. The returns for the four years are 20%, -10%, 15%, and -5%. Calculate the arithmetic average return and the geometric average return.
5. You are considering purchasing shares in a company that has a beta of 0.9. The average return for the S&P 500 is 11%, and the average return for US Treasury bills has been 2%. Based on the CAPM, what is your expected return for the stock?
6. Your portfolio has had a 15% rate of return with a standard deviation of 18% and a beta of 1.1. The average return for the S&P 500 has been 11%, and the average return for US Treasury bills has been 2%. Calculate the Sharpe ratio, Treynor ratio, and Jensen's alpha for your portfolio.
7. The monthly returns for Visa (V) and Pfizer (PFE) for 2018–2020 are provided in the chart below. In addition, the monthly return for the SPDR S&P 500 ETF Trust (SPY) is provided; SPY is often used as a proxy for the returns of the S&P 500, or a broad market index. Using Excel, calculate the arithmetic average monthly returns for V, PFE, and SPY. Also, calculate the standard deviation of returns for each of V, PFE, and SPY.
   Monthly Returns for SPY, V, and PFE for 2018–2020

| Date | SPY | V | PFE |
|---|---|---|---|
| Jan-18 | 0.0618 | 0.0895 | 0.0226 |
| Feb-18 | -0.0364 | -0.0104 | -0.0197 |
| Mar-18 | -0.0313 | -0.0253 | -0.0135 |
| Apr-18 | 0.0092 | 0.0607 | 0.0316 |
| May-18 | 0.0243 | 0.0303 | -0.0186 |
| Jun-18 | 0.0013 | 0.0149 | 0.0196 |
| Jul-18 | 0.0417 | 0.0324 | 0.1006 |
| Aug-18 | 0.0319 | 0.0742 | 0.0398 |
| Sep-18 | 0.0014 | 0.0233 | 0.0705 |
| Oct-18 | -0.0649 | -0.0816 | -0.0229 |
| Nov-18 | 0.0185 | 0.0280 | 0.0736 |
| Dec-18 | -0.0933 | -0.0673 | -0.0485 |

**Table 15.8**

| Date | SPY | V | PFE |
|---|---|---|---|
| Jan-19 | 0.0864 | 0.0233 | -0.0275 |
| Feb-19 | 0.0324 | 0.0971 | 0.0301 |
| Mar-19 | 0.0136 | 0.0563 | -0.0203 |
| Apr-19 | 0.0454 | 0.0528 | -0.0438 |
| May-19 | -0.0638 | -0.0189 | 0.0224 |
| Jun-19 | 0.0644 | 0.0774 | 0.0526 |
| Jul-19 | 0.0201 | 0.0256 | -0.1034 |
| Aug-19 | -0.0167 | 0.0158 | -0.0847 |
| Sep-19 | 0.0148 | -0.0473 | 0.0201 |
| Oct-19 | 0.0268 | 0.0398 | 0.0679 |
| Nov-19 | 0.0362 | 0.0316 | 0.0039 |
| Dec-19 | 0.0240 | 0.0201 | 0.0270 |
| Jan-20 | 0.0045 | 0.0589 | -0.0495 |
| Feb-20 | -0.0792 | -0.0865 | -0.0934 |
| Mar-20 | -0.1300 | -0.1123 | -0.0233 |
| Apr-20 | 0.1336 | 0.1092 | 0.1752 |
| May-20 | 0.0476 | 0.0924 | -0.0044 |
| Jun-20 | 0.0133 | -0.0089 | -0.1352 |
| Jul-20 | 0.0636 | -0.0143 | 0.1768 |
| Aug-20 | 0.0698 | 0.1134 | -0.0083 |
| Sep-20 | -0.0413 | -0.0553 | -0.0288 |
| Oct-20 | -0.0210 | -0.0913 | -0.0332 |
| Nov-20 | 0.1088 | 0.1576 | 0.1381 |
| Dec-20 | 0.0326 | 0.0414 | -0.0293 |

**Table 15.8**

8. Using the monthly returns provided in the table in problem 7, use Excel to calculate the beta for V and the beta for PFE. Which of these stocks has more systematic risk? What would you expect for the comparative returns of V and PFE?

## Video Activity

### How to Double Your Money in Seven Years

Access multimedia content (http://openstax.org/books/principles-finance/pages/15-video-activity)
In this video, Jim Cramer explains how compounding can help investors build and preserve wealth. He provides suggestions for how young people can use the stock market to build financial independence.

1. According to Jim Cramer, if you invest $1,000 in the S&P 500, how much can you expect your investment to be worth in 35 years?
2. Gather data over the past 10 years for the level of the S&P 500. How many of those years did the S&P 500 have a return of at least 10%? If you had invested in $1,000 in an S&P 500 index fund 10 years ago, would

you have doubled your money yet? Is your answer consistent with Jim Cramer's message?

## John Bogle and the Buy-and-Hold Strategy

Access multimedia content (http://openstax.org/books/principles-finance/pages/15-video-activity)
In this video, the legendary investor Jack Bogle, founder and former CEO of Vanguard, discusses strategies for investors.

3. When discussing following a buy-and-hold strategy, in which an investor makes a purchase and holds the same investment for the long term, Bogle says that the success of such a strategy depends on what is bought. What distinction does Bogle make between buying and holding an individual stock and buying and holding a broad-based index fund?
4. How would you describe Bogle's attitude toward risk in the stock market? Do you agree with this attitude? Why or why not?

16

# How Companies Think about Investing

**Figure 16.1** Companies make decisions about investments every day. (credit: modification of "Tesla Factory, Fremont (CA, USA)" by Maurizio Pesce/flickr, CC BY 2.0)

## Chapter Outline


**16.1** Payback Period Method
**16.2** Net Present Value (NPV) Method
**16.3** Internal Rate of Return (IRR) Method
**16.4** Alternative Methods
**16.5** Choosing between Projects
**16.6** Using Excel to Make Company Investment Decisions


## Why It Matters

One of the most important decisions a company faces is choosing which investments it should make. Should an automobile manufacturer purchase a new robot for its assembly line? Should an airline purchase a new plane to add to its fleet? Should a hotel chain build a new hotel in Atlanta? Should a bakery purchase tables and chairs to provide places for customers to eat? Should a pharmaceutical company spend money on research for a new vaccine? All of these questions involve spending money today to make money in the future.

The process of making these decisions is often referred to as **capital budgeting**. In order to grow and remain competitive, a firm relies on developing new products, improving existing products, and entering new markets. These new ventures require investments in fixed assets. The company must decide whether the project will generate enough cash to cover the costs of these initial expenditures once the project is up and running.

For example, Sam's Sporting Goods sells sporting equipment and uniforms to players on local recreational and school teams. Customers have been inquiring about customizing items such as baseball caps and equipment bags with logos and other designs. Sam's is considering purchasing an embroidery machine so that it can provide these customized items in-house. The machine will cost $16,000. Purchasing the embroidery machine would be an investment in a fixed asset. If it purchases the machine, Sam's will be able to charge customers for customization.

The managers think that selling customized items will allow the company to increase its cash flow by $2,000

next year. They predict that as customers become more aware of this service, the ability to customize products in-house will increase the company's cash flow by $4,000 the following year. The managers expect the machine will be used for five years, with the embroidery products increasing cash flows by $5,000 during each of the last three years the machine is used. Should Sam's Sporting Goods invest in the embroidery machine? In this chapter, we consider the main capital budgeting techniques Sam's and other companies can use to evaluate these types of decisions.

# 16.1 Payback Period Method

## Learning Outcomes

By the end of this section, you will be able to:

- Define payback period.
- Calculate payback period.
- List the advantages and disadvantages of using the payback period method.

The payback period method provides a simple calculation that the managers at Sam's Sporting Goods can use to evaluate whether to invest in the embroidery machine. The **payback period** calculation focuses on how long it will take for a company to make enough free cash flow from the investment to recover the initial cost of the investment.

## Payback Period Calculation

In order to purchase the embroidery machine, Sam's Sporting Goods must spend $16,000. During the first year, Sam's expects to see a $2,000 benefit from purchasing the machine, but this means that after one year, the company will have spent $14,000 more than it has made from the project. During the second year that it uses the machine, Sam's expects that its cash inflow will be $4,000 greater than it would have been if it had not had the machine. Thus, after two years, the company will have spent $10,000 more than it has benefited from the machine. This process is continued year after year until the accumulated increase in cash flow is $16,000, or equal to the original investment. The process is summarized in Table 16.1.

| Year | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Initial Investment ($) | (16,000) | | | | | |
| Cash Inflow ($) | - | 2,000 | 4,000 | 5,000 | 5,000 | 5,000 |
| Accumulated Inflow ($) | - | 2,000 | 6,000 | 11,000 | 16,000 | 21,000 |
| Balance ($) | (16,000) | (14,000) | (10,000) | (5,000) | - | 5,000 |

**Table 16.1**

Sam's Sporting Goods is expecting its cash inflow to increase by $16,000 over the first four years of using the embroidery machine. Thus, the payback period for the embroidery machine is four years. In other words, it takes four years to accumulate $16,000 in cash inflow from the embroidery machine and recover the cost of the machine.

LINK TO LEARNING

### Calculating the Payback Period

It is possible that a project will not fully recover the initial cost in one year but will have more than recovered its initial cost by the following year. In these cases, the payback period will not be an integer but will contain a fraction of a year. This video demonstrates how to calculate the payback period (https://openstax.org/r/how-to-calculate) in such a situation.

## Advantages

The principal advantage of the payback period method is its simplicity. It can be calculated quickly and easily. It is easy for managers who have little finance training to understand. The payback measure provides information about how long funds will be tied up in a project. The shorter the payback period of a project, the greater the project's liquidity.

## Disadvantages

Although it is simple to calculate, the payback period method has several shortcomings. First, the payback period calculation ignores the time value of money. Suppose that in addition to the embroidery machine, Sam's is considering several other projects. The cash flows from these projects are shown in Table 16.2. Both Project B and Project C have a payback period of five years. For both of these projects, Sam's estimates that it will take five years for cash inflows to add up to $16,000. The payback period method does not differentiate between these two projects.

| Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| Project A ($) | (16,000) | 2,000 | 4,000 | 5,000 | 5,000 | 5,000 | 5,000 |
| Project B ($) | (16,000) | 1,000 | 2,000 | 3,000 | 4,000 | 6,000 | - |
| Project C ($) | (16,000) | 6,000 | 4,000 | 3,000 | 2,000 | 1,000 | - |
| Project D ($) | (16,000) | 1,000 | 2,000 | 3,000 | 4,000 | 6,000 | 8,000 |

**Table 16.2**

However, we know that money has a time value, and receiving $6,000 in year 1 (as occurs in Project C) is preferable to receiving $6,000 in year 5 (as in Projects B and D). From what we learned about the time value of money, Projects B and C are not identical projects. The payback period method breaks the important finance rule of not adding or comparing cash flows that occur in different time periods.

A second disadvantage of using the payback period method is that there is not a clearly defined acceptance or rejection criterion. When the payback period method is used, a company will set a length of time in which a project must recover the initial investment for the project to be accepted. Projects with longer payback periods than the length of time the company has chosen will be rejected. If Sam's were to set a payback period of four years, Project A would be accepted, but Projects B, C, and D have payback periods of five years and so would be rejected. Sam's choice of a payback period of four years would be arbitrary; it is not grounded in any financial reasoning or theory. No argument exists for a company to use a payback period of three, four, five, or any other number of years as its criterion for accepting projects.

A third drawback of this method is that cash flows after the payback period are ignored. Projects B, C, and D all have payback periods of five years. However, Projects B and C end after year 5, while Project D has a large cash flow that occurs in year 6, which is excluded from the analysis. The payback method is shortsighted in that it favors projects that generate cash flows quickly while possibly rejecting projects that create much larger cash flows after the arbitrary payback time criterion.

Fourth, no risk adjustment is made for uncertain cash flows. No matter how careful the planning and analysis, a business is seldom sure what future cash flows will be. Some projects are riskier than others, with less certain cash flows, but the payback period method treats high-risk cash flows the same way as low-risk cash flows.

# 16.2 Net Present Value (NPV) Method

## Learning Outcomes

By the end of this section, you will be able to:

- Define net present value.
- Calculate net present value.
- List the advantages and disadvantages of using the net present value method.
- Graph an NPV profile.

## Net Present Value (NPV) Calculation

Sam's purchasing of the embroidery machine involves spending money today in the hopes of making more money in the future. Because the cash inflows and outflows occur in different time periods, they cannot be directly compared to each other. Instead, they must be translated into a common time period using time value of money techniques. By converting all of the cash flows that will occur from a project into present value, or current dollars, the cash inflows from the project can be compared to the cash outflows. If the cash inflows exceed the cash outflows in present value terms, the project will add value and should be accepted. The difference between the present value of the cash inflows and the present value of cash outflows is known as **net present value (NPV)**.

The equation for NPV can be written as

$$\text{NPV} = \text{PV}(\text{Cash Inflows}) - \text{PV}(\text{Cash Outflows}) \tag{16.1}$$

Consider Sam's Sporting Goods' decision of whether to purchase the embroidery machine. If we assume that after six years the embroidery machine will be obsolete and the project will end, when placed on a timeline, the project's expected cash flow is shown in Table 16.3:

| Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| Cash Flow ($) | (16,000) | 2,000 | 4,000 | 5,000 | 5,000 | 5,000 | 5,000 |

**Table 16.3**

Calculating NPV is simply a time value of money problem in which each cash flow is discounted back to the present value. If we assume that the cost of funds for Sam's is 9%, then the NPV can be calculated as

$$\begin{aligned}\text{NPV} &= \frac{\$2{,}000}{1.09^1} + \frac{\$4{,}000}{1.09^2} + \frac{\$5{,}000}{1.09^3} + \frac{\$5{,}000}{1.09^4} + \frac{\$5{,}000}{1.09^5} + \frac{\$5{,}000}{1.09^6} - \$16{,}000 \\ &= \$1{,}834.86 + \$3{,}366.72 + \$3{,}860.92 + \$3{,}542.13 + \$3{,}249.66 + \$2{,}981.34 - \$16{,}000 \\ &= \$2{,}835.63\end{aligned} \tag{16.2}$$

Because the NPV is positive, Sam's Sporting Goods should purchase the embroidery machine. The value of the firm will increase by $2,835.63 as a result of accepting the project.

Calculating NPV involves computing the present value of each cash flow and then summing the present values of all cash flows from the project. This project has six future cash flows, so six present values must be computed. Although this is not difficult, it is tedious.

A financial calculator is able to calculate a series of present values in the background for you, automating much of the process. You simply have to provide the calculator with each cash flow, the time period in which each cash flow occurs, and the discount rate that you want to use to discount the future cash flows to the present.

Follow the steps in Table 16.4 for calculating NPV:

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 1 | Select cash flow worksheet | CF | CF0 | XXXX |
| 2 | Clear the cash flow worksheet | 2ND [CLR WORK] | CF0 | 0 |
| 3 | Enter initial cash flow | 16000 +/− ENTER | CF0 = | -16,000.00 |
| 4 | Enter cash flow for the first year | ↓ 2000 ENTER | C01 = | 2,000.00 |
| | | ↓ | F01 = | 1.0 |
| 5 | Enter cash flow for the second year | ↓ 4000 ENTER | C02 = | 4,000.00 |
| | | ↓ | F02 = | 1.0 |
| 6 | Enter cash flow for the third year | ↓ 5000 ENTER | C03 = | 5,000.00 |
| | | ↓ | F03 = | 1.0 |
| 7 | Enter cash flow for the fourth year | ↓ 5000 ENTER | C04 = | 5,000.00 |
| | | ↓ | F04 = | 1.0 |
| 8 | Enter cash flow for the fifth year | ↓ 5000 ENTER | C05 = | 5,000.00 |
| | | ↓ | F05 = | 1.0 |
| 9 | Enter cash flow for the sixth year | ↓ 5000 ENTER | C06 = | 5,000.00 |
| | | ↓ | F06 = | 1.0 |
| 10 | Select NPV | NPV | I | 0.00 |
| 11 | Enter discount rate | 9 ENTER | I = | 9.00 |
| 12 | Compute NPV | ↓ CPT | NPV = | 2,835.63 |

**Table 16.4 Calculator Steps for NPV**[1]

LINK TO LEARNING

Net Present Value

This video provides another example of how to use NPV (https://openstax.org/r/how-to-use-NPV) to evaluate whether a project should be accepted or rejected.

## Advantages

The NPV method solves several of the listed problems with the payback period approach. First, the NPV method uses the time value of money concept. All of the cash flows are discounted back to their present value to be compared. Second, the NPV method provides a clear decision criterion. Projects with a positive NPV should be accepted, and projects with a negative NPV should be rejected. Third, the discount rate used to discount future cash flows to the present can be increased or decreased to adjust for the riskiness of the project's cash flows.

## Disadvantages

The NPV method can be difficult for someone without a finance background to understand. Also, the NPV method can be problematic when available capital resources are limited. The NPV method provides a criterion for whether or not a project is a good project. It does not always provide a good solution when a company

1 The specific financial calculator in these examples is the Texas Instruments BA II Plus™ Professional model, but you can use other financial calculators for these types of calculations.

must make a choice between several acceptable projects because funds are not available to pursue them all.

## THINK IT THROUGH

### Calculating NVP

Suppose your company is considering a project that will cost $30,000 this year. The cash inflow from this project is expected to be $6,000 next year and $8,000 the following year. The cash inflow is expected to increase by $2,000 yearly, resulting in a cash inflow of $18,000 in year 7, the final year of the project. You know that your company's cost of funds is 9%. Use a financial calculator to calculate NPV to determine whether this is a good project for your company to undertake (see Table 16.5).

**Solution:**

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 1 | Select cash flow worksheet | CF | CF0 | XXXX |
| 2 | Clear the cash flow worksheet | 2ND [CLR WORK] | CF0 | 0 |
| 3 | Enter initial cash flow | 30000 +/− ENTER | CF0 = | -30,000.00 |
| 4 | Enter cash flow for the first year | ↓ 6000 ENTER | C01 = | 6,000.00 |
| | | ↓ | F01 = | 1.0 |
| 5 | Enter cash flow for the second year | ↓ 8000 ENTER | C02 = | 8,000.00 |
| | | ↓ | F02 = | 1.0 |
| 6 | Enter cash flow for the third year | ↓ 10000 ENTER | C03 = | 10,000.00 |
| | | ↓ | F03 = | 1.0 |
| 7 | Enter cash flow for the fourth year | ↓ 12000 ENTER | C04 = | 12,000.00 |
| | | ↓ | F04 = | 1.0 |
| 8 | Enter cash flow for the fifth year | ↓ 14000 ENTER | C05 = | 14,000.00 |
| | | ↓ | F05 = | 1.0 |
| 9 | Enter cash flow for the sixth year | ↓ 16000 ENTER | C06 = | 16,000.00 |
| | | ↓ | F06 = | 1.0 |
| 10 | Enter cash flow for the seventh year | ↓ 18000 ENTER | C07 = | 18,000.00 |
| | | ↓ | F07 = | 1.0 |
| 11 | Select NPV | NPV | I | 0.00 |
| 12 | Enter discount rate | 9 ENTER | I = | 9.00 |
| 13 | Compute NPV | ↓ CPT | NPV = | 26,946.90 |

**Table 16.5 Calculator Steps for NPV**

The NPV for this project is $26,946.90. Undertaking this project will add a net present value of $26,946.90; therefore, this is a good project that should be undertaken.

LINK TO LEARNING

### Calculating the NPV of an MBA Program

The NPV calculation can be used as a decision tool when you are deciding whether you should spend money today to make money in the future. This website on calculating the NPV on an MBA degree (https://openstax.org/r/calculating-the-NPV) lets you apply this concept in an educational setting. The initial cost of the MBA includes both the dollars spent on tuition and the wages that a full-time student could have earned if they were not in school. Why is it appropriate to include these forgone wages in the calculation? What adjustments would students need to make to this analysis if they wanted to consider attending a part-time MBA program that allowed them to continue working while completing the program?

## NPV Profile

The NPV of a project depends on the expected cash flows from the project and the discount rate used to translate those expected cash flows to the present value. When we used a 9% discount rate, the NPV of the embroidery machine project was $2,836. If a higher discount rate is used, the present value of future cash flows falls, and the NPV of the project falls.

Theoretically, we should use the firm's cost to attract capital as the discount rate when calculating NPV. In reality, it is difficult to estimate this cost of capital accurately and confidently. Because the discount rate is an approximate value, we want to determine whether a small error in our estimate is important to our overall conclusion. We can do this by creating an NPV profile, which graphs the NPV at a variety of discount rates and allows us to determine how sensitive the NPV is to changes in the discount rate.

To construct an NPV profile for Sam's, select several discount rates and compute the NPV for the embroidery machine project using each of those discount rates. Table 16.6 below shows the NPV for several discount rates. Notice that if the discount rate is zero, the NPV is simply the sum of the cash flows. As the discount rate becomes larger, the NPV falls and eventually becomes negative.

The information in Table 16.6 is presented in a graph in Figure 16.2. We can see that the graph crosses the horizontal axis at about 14%. To the left, or at lower discount rates, the NPV is positive. If you are confident that the firm's cost of attracting funds is less than 14%, the company should accept the project. If the cost of capital is more than 14%, however, the NPV is negative, and the company should reject the project.

| Discount Rate | NPV ($) |
|---|---|
| 0% | 10,000 |
| 3% | 7,231 |
| 9% | 2,836 |
| 12% | 1,081 |
| 14% | 42 |
| 15% | (442) |
| 18% | (1,773) |
| 21% | (2,939) |

**Table 16.6 NPV for Various Discount Rates**

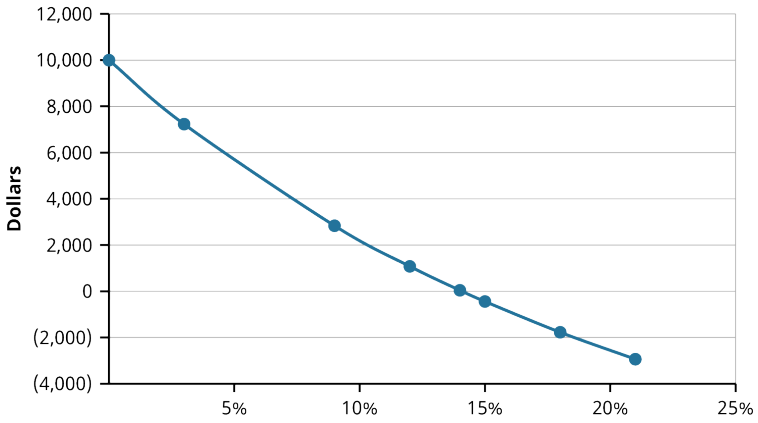



**Figure 16.2 NPV Profile Graph**

# 16.3 Internal Rate of Return (IRR) Method

## Learning Outcomes

By the end of this section, you will be able to:

- Define internal rate of return (IRR).
- Calculate internal rate of return.
- List advantages and disadvantages of using the internal rate of return method.

## Internal Rate of Return (IRR) Calculation

The **internal rate of return (IRR)** is the discount rate that sets the present value of the cash inflows equal to the present value of the cash outflows. In considering whether Sam's Sporting Goods should purchase the embroidery machine, the IRR method approaches the time value of money problem from a slightly different angle. Instead of using the company's cost of attracting funds for the discount rate and solving for NPV, as we did in the first NPV equation, we set NPV equal to zero and solve for the discount rate to find the IRR:

$$\text{NPV} = \frac{\$2{,}000}{(1+i)^1} + \frac{\$4{,}000}{(1+i)^2} + \frac{\$5{,}000}{(1+i)^3} + \frac{\$5{,}000}{(1+i)^4} + \frac{\$5{,}000}{(1+i)^5} + \frac{\$5{,}000}{(1+i)^6} - \$16{,}000 = 0 \quad \textbf{16.3}$$

The IRR is the discount rate at which the NPV profile graph crosses the horizontal axis. If the IRR is greater than the cost of capital, a project should be accepted. If the IRR is less than the cost of capital, a project should be rejected. The NPV profile graph for the embroidery machine crossed the horizontal axis at 14%. Therefore, if Sam's Sporting Goods can attract capital for less than 14%, the IRR exceeds the cost of capital and the embroidery machine should be purchased. However, if it costs Sam's more than 14% to attract capital, the embroidery machine should not be purchased.

In other words, a company wants to accept projects that have an IRR that exceed the company's cost of attracting funds. The cash flow from these projects will be great enough to cover the cost of attracting money from investors in addition to the other costs of the project. A company should reject any project that has an IRR less than the company's cost of attracting funds; the cash flows from such a project are not enough to compensate the investors for the use of their funds.

Calculating IRR without a financial calculator is an arduous, time-consuming process that requires trial and error to find the discount rate that makes NPV exactly equal zero. Your calculator uses the same type of trial-and-error iterative process, but because it uses an automated process, it can do so much more quickly than you can. A problem that might require 30 minutes of detailed mathematical calculations by hand can be completed in a matter of seconds with the assistance of a financial calculator.

All the information your calculator needs to calculate IRR is the value of each cash flow and the time period in which it occurs. To calculate IRR, begin by entering the cash flows for the project, just as you do for the NPV

calculation (see Table 16.7). After these cash flows are entered, simply compute IRR in the final step.

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 1 | Select cash flow worksheet | CF | CF0 | XXXX |
| 2 | Clear the cash flow worksheet | 2ND [CLR WORK] | CF0 | 0 |
| 3 | Enter initial cash flow | 16000 +/− ENTER | CF0 = | -16,000.00 |
| 4 | Enter cash flow for the first year | ↓ 2000 ENTER | C01 = | 2,000.00 |
| | | ↓ | F01 = | 1.0 |
| 5 | Enter cash flow for the second year | ↓ 4000 ENTER | C02 = | 4,000.00 |
| | | ↓ | F02 = | 1.0 |
| 6 | Enter cash flow for the third year | ↓ 5000 ENTER | C03 = | 5,000.00 |
| | | ↓ | F03 = | 1.0 |
| 7 | Enter cash flow for the fourth year | ↓ 5000 ENTER | C04 = | 5,000.00 |
| | | ↓ | F04 = | 1.0 |
| 8 | Enter cash flow for the fifth year | ↓ 5000 ENTER | C05 = | 5,000.00 |
| | | ↓ | F05 = | 1.0 |
| 9 | Enter cash flow for the sixth year | ↓ 5000 ENTER | C06 = | 5,000.00 |
| | | ↓ | F06 = | 1.0 |
| 10 | Compute IRR | IRR CPT | IRR = | 14.09 |

**Table 16.7 Calculator Steps for IRR**

## Advantages

The primary advantage of using the IRR method is that it is easy to interpret and explain. Investors like to speak in terms of annual percentage returns when evaluating investment possibilities.

## Disadvantages

One disadvantage of using IRR is that it can be tedious to calculate. We knew the IRR was about 14% for the embroidery machine project because we had previously calculated the NPV for several discount rates. The IRR is about, but not exactly, 14%, because NPV is not exactly equal to zero (just very close to zero) when we use 14% as the discount rate. Before the prevalence of financial calculators and spreadsheets, calculating the exact IRR was difficult and time-consuming. With today's technology, this is no longer a major consideration. Later in this chapter, we will look at how to use a spreadsheet to do these calculations.

**No Single Mathematical Solution.** Another disadvantage of using the IRR method is that there may not be a single mathematical solution to an IRR problem. This can happen when negative cash flows occur in more than one period in the project. Suppose your company is considering building a facility for an upcoming Olympic competition. The construction cost would be $350 million. The facility would be used for one year and generate cash inflows of $950 million. Then, the following year, your company would be required to convert the facility into a public park area for the city, which is expected to cost $620 million. Placing these cash flows

in a timeline results in the following (Table 16.8):

| Year | 0 | 1 | 2 |
|---|---|---|---|
| Cash Flow ($Millions) | (350) | 950 | (620) |

**Table 16.8**

The NPV profile for this project looks like Figure 16.3. The NPV is negative at low interest rates, becomes positive at higher interest rates, and then turns negative again as the interest rate continues to rise. Because the NPV profile line crosses the horizontal axis twice, there are two IRRs. In other words, there are two interest rates at which NPV equals zero.

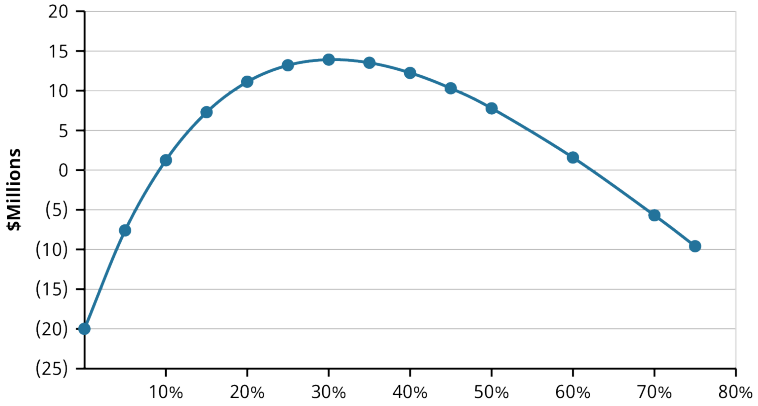



**Figure 16.3 NPV Profile Graph for a Project with Two IRRs**

**Reinvestment Rate Assumption.** The IRR assumes that the cash flows are reinvested at the internal rate of return when they are received. This is a disadvantage of the IRR method. The firm may not be able to find any other projects with returns equal to a high-IRR project, so the company may not be able to reinvest at the IRR.

The reinvestment rate assumption becomes problematic when a company has several acceptable projects and is attempting to rank the projects. We will look more closely at the issues that can arise when considering mutually exclusive projects later in this chapter. If a company is simply deciding whether to accept a single project, the reinvestment assumption limitation is not relevant.

**Overlooking Differences in Scale.** Another disadvantage of using the IRR method to choose among various acceptable projects is that it ignores differences in scale. The IRR converts the cash flows to percentages and ignores differences in the size or scale of projects. Issues that occur when comparing projects of different scales are covered later in this chapter.

# 16.4 Alternative Methods

## Learning Outcomes

By the end of this section, you will be able to:

- Calculate profitability index.
- Calculate discounted payback period.
- Calculate modified internal rate of return.

## Profitability Index (PI)

The **profitability index (PI)** uses the same inputs as the NPV calculation, but it converts the results to a ratio. The numerator is the present value of the benefits of doing a project. The denominator is the present value of the cost of doing the project. The formula for calculating PI is

$$\text{PI} = \frac{\text{PV(Cash Inflows)}}{\text{PV(Cash Outflows)}} \quad \textbf{16.4}$$

For the embroidery machine project that Sam's Sporting Goods is considering, the PI would be calculated as

$$\text{PI} = \frac{\$18{,}836}{\$16{,}000} = 1.18 \quad \textbf{16.5}$$

The numerator of the PI formula is the benefit of the project, and the denominator is the cost of the project. Thus, the PI is the benefit relative to the cost. When NPV is greater than zero, PI will be greater than 1. When NPV is less than zero, PI will be less than 1. Therefore, the decision criterion using the PI method is to accept a project if the PI is greater than 1 and reject a project if the PI is less than 1.

Note that the NPV method and the PI method of project evaluation will always provide the same answer to the accept-or-reject question. The advantage of using the PI method is that it is helpful in ranking projects from best to worst. Issues that arise when ranking projects are discussed later in this chapter.

## Discounted Payback Period

The payback period method provides a fast, simple approach to evaluating a project, but it suffers from the fact that it ignores the time value of money. The **discounted payback period** method addresses this flaw by discounting cash flows using the company's cost of funds and then using these discounted values to determine the payback period.

Consider Sam's Sporting Goods' decision regarding whether to purchase an embroidery machine. The expected cash flows and their values when discounted using the company's 9% cost of funds are shown in Table 16.9. Earlier, we calculated the project's payback period as four years; that is how long it would take the company to recover all of the cash that it would spend on the project. Remember, however, that the payback period does not consider the company's cost of funds, so it underestimates the true breakeven time period.

| Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| Cash Flow ($) | (16,000.00) | 2,000.00 | 4,000.00 | 5,000.00 | 5,000.00 | 5,000.00 | 5,000.00 |
| Discounted Cash Flow ($) | (16,000) | 1,834.86 | 3,366.72 | 3,860.92 | 3,542.13 | 3,249.66 | 2,981.34 |
| Cumulative Discounted Cash Flow ($) | (16,000.00) | (14,165.14) | (10,798.42) | (6,937.50) | (3,395.37) | (145.72) | 2,835.62 |

**Table 16.9**

When the cash flows are appropriately discounted, the project still has not broken even by the end of year 5. The discounted payback period would be $5 + \frac{145.72}{2{,}981.34} = 5.05$ years. This adjusted calculation addresses the payback period method's flaw of not considering the time value of money, but managers are still confronted with the other disadvantages. No objective criterion for acceptance or rejection exists because of the lack of a theoretical underpinning for what is an acceptable payback period length. The discounted payback period ignores any cash flows after breakeven occurs; this is a serious drawback, especially when comparing mutually exclusive projects.

## Modified Internal Rate of Return (MIRR)

Financial analysts have developed an alternative evaluation technique that is similar to the IRR but modified in an attempt to address some of the weakness of the IRR method. This **modified internal rate of return (MIRR)** is calculated using the following steps:

1. Find the present value of all of the cash outflows using the firm's cost of attracting capital as the discount rate.
2. Find the future value of all cash inflows using the firm's cost of attracting capital as the discount rate. All

cash inflows are compounded to the point in time at which the last cash inflow will be received. The sum of the future value of cash inflows is known as the project terminal value.

3. Compute the yield that sets the future value of the inflows equal to the present value of the outflows. This yield is the modified internal rate of return.

For our embroidery machine project, the MIRR would be calculated as shown in Table 16.10:

| Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| Cash Flow ($) | (16,000.00) | 2,000.00 | 4,000.00 | 5,000.00 | 5,000.00 | 5,000.00 | 5,000.00 |
| | | | | | | | 3,077.25 |
| | | | | | | | 5,646.33 |
| | | | | | | | 6,475.15 |
| | | | | | | | 5,940.50 |
| | | | | | | | 5,450.00 |
| | | | | | | **Terminal Value** | **$31,595.22** |

**Table 16.10**

1. The only cash outflow is the $16,000 at time period 0.
2. The future value of each of the six expected cash inflows is calculated using the company's 9% cost of attracting capital. Each of the cash flows is translated to its value in time period 6, the time period of the final cash inflow. The sum of the future value of these six cash flows is $31,595.22. Thus, the terminal value is $31,595.22
3. The interest rate that equates the present value of the outflows, $16,000, to the terminal value of $31,595.22 six years later is found using the formula

$$\begin{aligned} \$16{,}000(1 + i)^6 &= \$31{,}595.22 \\ (1 + i)^6 &= 1.97 \\ i &= 0.12 = 12\% \end{aligned} \qquad \textbf{16.6}$$

The MIRR solves the reinvestment rate assumption problem of the IRR method because all cash flows are compounded at the cost of capital. In addition, solving for MIRR will result in only one solution, unlike the IRR, which may have multiple mathematical solutions. However, the MIRR method, like the IRR method, suffers from the limitation that it does not distinguish between large-scale and small-scale projects. Because of this limitation, the MIRR cannot be used to rank projects; it can only be used to make accept-or-reject decisions.

## 16.5 Choosing between Projects

### Learning Outcomes

By the end of this section, you will be able to:

- Choose between mutually exclusive projects.
- Compare projects with different lives.
- Compare projects of different scales.
- Rank projects when resources are limited.

So far, we have considered methods for deciding to accept or to reject a single stand-alone project. Sometimes, managers must make decisions regarding which of two projects to accept, or a company might be faced with a number of good, acceptable projects and have to decide which of those projects to take on during the current year.

## Choosing between Mutually Exclusive Projects

Earlier in this chapter, we saw that the embroidery machine that Sam's Sporting Goods was considering had a positive NPV, making it a project that Sam's should accept. However, another, more expensive embroidery machine may be available that is able to make more stitches per minute. Although the initial cost of this heavy-duty machine is higher, it would allow Sam's to embroider and sell more items each year, generating more revenue. The two embroidery machines are **mutually exclusive projects**. Mutually exclusive projects compete with one another; purchasing one embroidery machine excludes Sam's from purchasing the other embroidery machine.

Table 16.11 shows the cash outflow and inflows expected from the original embroidery machine considered as well as the heavy-duty machine. The heavy-duty machine costs $25,000, but it will generate more cash inflows in years 3 through 6. Both machines have a positive NPV, leading to decisions to accept the projects. Also, both machines have an IRR exceeding the company's 9% cost of raising capital, also leading to decisions to accept the projects.

When considered by themselves, each of the machines is a good project for Sam's to pursue. The question the managers face is which is the better of the two projects. When faced with this type of decision, the rule is to take the project with the highest NPV. Remember that the goal is to choose projects that add value to the company. Because the NPV of a project is the estimate of how much value it will create, choosing the project with the higher NPV is choosing the project that will create the greater value.

| Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 | NPV | IRR |
|---|---|---|---|---|---|---|---|---|---|
| Regular Machine ($) | (16,000) | 2,000 | 4,000 | 5,000 | 5,000 | 5,000 | 5,000 | **2,835.62** | **14.10%** |
| Heavy-Duty Machine ($) | (25,000) | 2,000 | 4,000 | 8,000 | 9,000 | 9,000 | 9,000 | **3,970.67** | **13.20%** |

**Table 16.11**

### LINK TO LEARNING

#### Olympic Project Economics

The investment analysis procedures used by companies are also used by government entities when evaluating projects. Olympic host cities receive direct revenues from broadcast rights, ticket sales, and licensing agreements. The cities also expect indirect benefits from increased tourism, including increased employment and higher tax revenues. These benefits come after the city makes a major investment in infrastructure, spending money on stadiums, housing, and transportation. The investment in infrastructure for the 2014 Winter Olympics in Sochi, Russia, was over $50 billion.[2] Why do you think the infrastructure investment for these games was so much higher than the amount spent by cities hosting previous games? If your city were discussing the possibility of bidding to be an Olympic host city, what would you suggest it consider when evaluating the opportunity? Check out this article (https://openstax.org/r/this-article) for more information.

## Choosing between Projects with Different Lives

Suppose you are considering starting an ice-cream truck business. You find that you can purchase a used truck for $50,000. You estimate that the truck will last for three years, and you will be able to sell enough ice cream treats to generate a cash inflow of $40,000 during each of those years. Your cost of capital is 10%. The positive NPV of $49,474 for the project makes this an acceptable project.

2 David Filipov. "Russia Spent $50 Billion on the Sochi Olympics. It Might Actually Have Been Worth It." Washington Post, November 15, 2017. https://www.washingtonpost.com/world/europe/that-sochi-olympic-boondoggle-russians-say-all-the-investment-is-paying-off/2017/11/13/65014bd0-b82c-11e7-9b93-b97043e57a22_story.html

Another ice-cream truck is also for sale for $50,000. This truck is smaller and will not be able to hold as many frozen treats. However, the truck is newer, with lower mileage, and you estimate that you can use it for six years. This newer truck will allow you to generate a cash inflow of $30,000 each year for the next six years. The NPV of the newer truck is $80,658.

Because both trucks are acceptable projects but you can only drive one truck at a time, you must choose which truck to purchase. At first, it may be tempting to purchase the newer, lower-mileage truck because of its higher NPV. Unfortunately, when comparing two projects that have different lives, a decision cannot be made simply by comparing the NPVs. Although the ice-cream truck with the six-year life span has a much higher NPV than the larger truck, it consumes your resources for a long time.

There are two methods for comparing projects with different lives. Both assume that when the short-life project concludes, another, similar project will be available.

## Replacement Chain Approach

With the **replacement chain approach**, as many short-life projects as necessary are strung together to equal the life of the long-life project. You can purchase the newer, lower-mileage ice-cream truck and run your business for six years. To make a comparison, you assume that if you purchase the larger truck that will last for three years, you will be able to repeat the same project, purchasing another larger truck that will last for the next three years. In essence, you are comparing a six-year project with two consecutive three-year projects so that both options will generate cash inflows for six years. Your timeline for the projects (comparing an older, larger truck with a newer, lower-mileage truck) will look like Table 16.12:

| Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| Older Truck ($) | ($50,000) | 40,000 | 40,000 | 40,000 | **40,000** | **40,000** | **40,000** |
| Older Truck ($) | | | | **(50,000)** | | | |
| | | | | | | | |
| Newer Truck ($) | (50,000) | 30,000 | 30,000 | 30,000 | 30,000 | 30,000 | 30,000 |

**Table 16.12**

The present values of all of the cash inflows and outflows from purchasing two of the older, larger trucks consecutively are added together to find the NPV of that alternative. The NPV of this alternative is $86,645, which is higher than the NPV of $80,658 of the newer truck, as shown in Table 16.13:

| Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| Older Truck ($) | | 40,000 | 40,000 | 40,000 | **40,000** | **40,000** | **40,000** |
| Older Truck ($) | | | | **(50,000)** | | | |
| Net Present Value | **(50,000)** | **36,363.64** | **33,057.85** | **(7,513.15)** | **27,320.54** | **24,836.85** | **22,578.96** |

$$\text{NPV} = \$86{,}644.69 \tag{16.7}$$

**Table 16.13**

When using the replacement chain approach, the short-term project is repeated any number of times to equal the length of the longer-term project. If one project is 5 years and another is 20 years, the short one is repeated four times. This method can become tedious when the length of the longer project is not a multiple of the shorter project. For example, when choosing between a five-year project and a seven-year project, the short one would have to be duplicated seven times and the long project would have to be repeated five times

to get to a common length of 35 years for the two projects.

### Equal Annuity Approach

The **equal annuity approach** assumes that both the short-term and the long-term projects can be repeated forever. This approach involves the following steps:

Step 1: Find the NPV of each of the projects.

- The NPV of the larger, older ice-cream truck is $49,474.
- The NPV of the smaller, newer ice-cream truck is $80,658.

Step 2: Find the annuity that has the same present value as the NPV and the same number of periods as the project.

- For the larger, older ice-cream truck, we want to find the three-year annuity that would have a present value of $49,474 when using a 10% discount rate. This is $19,894.
- For the smaller, newer ice-cream truck, we want to find the six-year annuity that would have a present value of $80,658 when using a 10% discount rate. This is $18,520.

Step 3: Assume that these projects, or similar projects, can be repeated over and over and that these annuities will continue forever. Calculate the present value of these annuities continuing forever using the perpetuity formula.

$$\begin{aligned} \text{PV(Larger Truck)} &= \frac{\$19{,}894}{0.10} = \$198{,}940 \\ \text{PV(Smaller Truck)} &= \frac{\$18{,}520}{0.10} = \$185{,}200 \end{aligned} \quad \textbf{16.8}$$

We again find that the older, larger truck is preferred to the newer, smaller truck.

These methods correct for unequal lives, but managers need to be aware that some unavoidable issues come up when these adjustments are made. Both the replacement chain and equal annuity approaches assume that projects can be replicated with identical projects in the future. It is important to note that this is not always a reasonable assumption; these replacement projects may not exist. Estimating cash flows from potential projects is prone to errors, as we will discuss in Financial Forecasting these errors are compounded and become more significant as projects are expected to be repeated. Inflation and changing market conditions are likely to result in cash flows varying in the future from our predictions, and as we go further into the future, these changes are potentially greater.

## Choosing Projects When Resources Are Limited

Choosing positive NPV projects adds value to a company. Although we often assume that the company will choose to pursue all positive NPV projects, in reality, managers often face a budget that restricts the amount of capital that they may invest in a given time period. Thus, managers are forced to choose among several positive NPV projects. The goal is to maximize the total NPV of the firm's projects while remaining within budget constraints.

LINK TO LEARNING

#### Profitability Index

Managers should reject any project with a negative NPV. When managers find themselves with an array of projects with a positive NPV, the profitability index can be used to choose among those projects. To learn more, watch this video about how a company might use the profitability index (https://openstax.org/r/might-use).

For example, suppose Southwest Manufacturing is considering the seven projects displayed in Table 16.14. Each of the projects has a positive NPV and would add value to the company. The firm has a budget of $200 million to put toward new projects in the upcoming year. Doing all seven of the projects would require initial investments totaling $430 million. Thus, although all of the projects are good projects, Southwest Manufacturing cannot fund them all in the upcoming year and must choose among these projects. Southwest Manufacturing could choose the combination of Projects A and D; the combination of Projects B, C, and E; or several other combinations of projects and exhaust its $200 million investment budget.

| Project | NPV ($Millions) | Initial Investment ($Millions) | Profitability Index | Cumulative Investment Required ($Millions) |
|---|---|---|---|---|
| A | 60 | 150 | 1.40 | 150 |
| B | 25 | 100 | 1.25 | 250 |
| C | 10 | 70 | 1.14 | 320 |
| D | 15 | 50 | 1.30 | 370 |
| E | 11 | 30 | 1.37 | 400 |
| F | 7 | 20 | 1.35 | 420 |
| G | 2 | 10 | 1.20 | 430 |

**Table 16.14 Projects Being Considered by Southwest Manufacturing**

To decide which combination results in the largest added NPV for the company, rank the projects based on their profitability index, as is done in Table 16.15. Projects A, E, and F should be chosen, as they have the highest profitability indexes. Because those three projects require a cumulative investment of $200 million, none of the remaining projects can be undertaken at the present time. Doing those three projects will add $78 million in NPV to the firm. Out of this set of choices, there is no combination of projects that is affordable given Southwest Manufacturing's budget that would add more than $78 million in NPV.

| Project | NPV ($Millions) | Initial Investment ($Millions) | Profitability Index | Cumulative Investment Required ($Millions) |
|---|---|---|---|---|
| A | 60 | 150 | 1.40 | 150 |
| E | 11 | 30 | 1.37 | 180 |
| F | 7 | 20 | 1.35 | 200 |
| D | 15 | 50 | 1.30 | 250 |
| B | 25 | 100 | 1.25 | 350 |
| G | 2 | 10 | 1.20 | 360 |
| C | 10 | 70 | 1.14 | 430 |

**Table 16.15 Projects Ranked by Profitability Index**

Notice that when choices must be made among projects, the decision cannot be made by simply ranking the projects from highest to lowest NPV. Project D has an NPV of $15 million, which is higher than both the $11 million of Project E and the $7 million of Project F. However, Project D requires $50 million for an initial investment. For the same $50 million of investment funds, Southwest Manufacturer can accept both Projects E and F for a total NPV of $18 million. Investment capital is a scare resource for this company. By ranking projects based on their profitability index, the company is able to determine the best way to allocate its scarce capital for the largest potential increase in NPV.

## CONCEPTS IN PRACTICE

### Capital Budgeting Challenges

Although the basic techniques of project evaluation are straightforward, real-world capital budgeting decisions are complex and multifaceted. The goal of capital budgeting is to choose the projects that will bring the most value to the shareholders of the company. The NPV rule provides a clear, concise criterion for which projects will bring value to the shareholders. It is important to remember, however, that all of the project valuation calculations are based on projected cash flows. These projected cash flows are estimates, based on the best educated guesses that a company makes about its business opportunities over the next few years. Because no company has a crystal ball that can predict the future, its calculation of NPV is an estimate of what it expects.

Think, for example, of an oil company deciding whether to drill for oil. The project will require expenditures on equipment, land, and other items. The cash inflows will depend on the likelihood of oil being found, the quantity of oil produced by the well, and the price at which the oil can be sold. If a company estimates that oil will sell for $100 per barrel during the next few years, the project will have a much higher NPV than if the company estimates that oil will sell for only $50 per barrel.

A project that has a positive NPV and is accepted when a company is planning how to allocate its capital toward investments may end up being a bad project that the company wishes it had avoided if the future is much different from what it projected. Managers must stay attuned to economic developments and reevaluate capital budgeting decisions when significant changes occur. In spring 2020, managers around the globe were faced with a dramatically changing economic environment amid a pandemic. Oil companies, for example, saw oil prices drop from over $50 per barrel at the beginning of March to under $15 per barrel by the end of April.

## LINK TO LEARNING

### Reducing Capital Spending

In June 2020, McKinsey & Company looked at major companies around the world that were reducing their capital expenditures in the face of the COVID-19 pandemic. These companies were cutting their capital budgets by 10% to 80% from their originally planned levels for 2020. Reductions were especially large in the oil and gas industry, as companies found their revenue projections, and thus the NPV of their planned projects, falling dramatically. In addition, companies found themselves needing to free up cash; with more limited cash resources, fewer positive NPV projects could be accepted and funded.[3] Due to the COVID-19 pandemic, many CFOs were challenged to stabilize their corporate cash flows. This article explains how quickly reducing capital spending (https://openstax.org/r/quickly-reducing), which is usually a quick enough fix, was able to help.

3 Tom Brinded, Zak Cutler, Erikhans Kok, and Prakash Parbhoo. "Resetting Capital Spending in the Wake of COVID-19." McKinsey & Company. June 25, 2020. https://www.mckinsey.com/business-functions/operations/our-insights/resetting-capital-spending-in-the-wake-of-covid-19

# 16.6 Using Excel to Make Company Investment Decisions

## Learning Outcomes

By the end of this section, you will be able to:

- Calculate NPV using Excel.
- Calculate IRR using Excel.
- Create an NPV profile using Excel.

A Microsoft Excel spreadsheet provides an alternative to using a financial calculator to automate the arithmetic necessary to calculate NPV and IRR. An advantage of using Excel is that you can quickly change any assumptions or numbers in your problem and recalculate NPV or IRR based on that updated information. Excel is a versatile tool with more than one way to set up most problems. We will consider a couple of straightforward examples of using Excel to calculate NPV and IRR.

Suppose your company is considering a project that will cost $30,000 this year. The cash inflow from this project is expected to be $6,000 next year and $8,000 the following year. The cash inflow is expected to increase by $2,000 yearly, resulting in a cash inflow of $18,000 in year 7, the final year of the project. You know that your company's cost of funds is 9%. Your company would like to evaluate this project.

## Calculating NPV Using Excel

To calculate NPV using Excel, you would begin by placing each year's expected cash flows in a sheet, as in row 5 in Figure 16.4. One approach to calculating NPV is to use the formula for discounting future cash flows, as is shown in row 6.

| | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | |
| 2 | **Company's Cost of Funds** | | **9%** | | | | | | | |
| 3 | | | | | | | | | | |
| 4 | | **Year** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| 5 | | Cash Flow | (30,000) | 6,000 | 8,000 | 10,000 | 12,000 | 14,000 | 16,000 | 18,000 |
| 6 | | Present Value of Cash Flow | =C5/(1+$C2)^C4 | =D5/(1+$C2)^D4 | =E5/(1+$C2)^E4 | =F5/(1+$C2)^F4 | =G5/(1+$C2)^G4 | =H5/(1+$C2)^H4 | =I5/(1+$C2)^I4 | =J5/(1+$C2)^J4 |
| 7 | | | | | | | | | **NPV =** | **=SUM(C6:J6)** |

**Figure 16.4 Inserting Present Cash Flows Using Excel ($ except Cost of Funds)**

Figure 16.5 shows the present value of each year's cash flow resulting from the formula. The NPV is then calculated by summing the present values of the cash flows.

*Download the spreadsheet file (https://openstax.org/r/spreadsheet-file) containing key Chapter 16 Excel exhibits.*

| | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | |
| 2 | **Company's Cost of Funds** | | **9%** | | | | | | | |
| 3 | | | | | | | | | | |
| 4 | | **Year** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| 5 | | Cash Flow | (30,000) | 6,000 | 8,000 | 10,000 | 12,000 | 14,000 | 16,000 | 18,000 |
| 6 | | Present Value of Cash Flow | (30,000) | 5,505 | 6,733 | 7,722 | 8,501 | 9,099 | 9,540 | 9,847 |
| 7 | | | | | | | | | **NPV =** | **26,947** |

**Figure 16.5 NPV Calculated by Summing Present Values of Cash Flows ($ except Cost of Funds)**

Alternatively, Excel is programmed with financial functions, including a calculation for NPV. The NPV formula is shown in cell J7 in Figure 16.6 below. However, it is important to pay attention to how Excel defines NPV. The Excel NPV function calculates the sum of the present values of the cash flows occurring from period 1 through the end of the project using the designated discount rate, but it fails to include the initial investment at time

period zero at the beginning of the project. The NPV function in cell J6 will return $56,947 for this project. You must subtract the initial cash outflow of $30,000 that occurs at time 0 to get the NPV of $26,947 for the project.

When entering the Excel-programmed NPV function, you must remember to include references only to the cells that contain cash flows from year 1 to the end of the project. Then, subtract the initial investment of year 0 to calculate NPV according to the standard definition of NPV—the present values of the cash inflows minus the present value of the cash outflow. Note: Because of the nonstandard use of the term NPV by Excel, many users prefer to use the method described above rather than this predefined function.

| | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | |
| 2 | **Company's Cost of Funds** | | **9%** | | | | | | | |
| 3 | | | | | | | | | | |
| 4 | | **Year** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| 5 | | Cash Flow | (30,000) | 6,000 | 8,000 | 10,000 | 12,000 | 14,000 | 16,000 | 18,000 |
| 7 | | | | | | | | | **NPV =** | **=NPV(C2,D5:J5)+C5** |

**Figure 16.6 NPV Formula ($ except IRR/Cost of Funds)**

## Calculating IRR Using Excel

Excel also provide a function for calculating IRR. This function is shown in Figure 16.7, cell J8. The IRR function properly uses all the project's cash flows, including the initial cash outflow at time 0, in its calculation, unlike the NPV function. This function will correctly return the IRR of 27.7% for the project. Figure 16.8 shows the completed spreadsheet.

| | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | |
| 2 | **Company's Cost of Funds** | | **9%** | | | | | | | |
| 3 | | | | | | | | | | |
| 4 | | **Year** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| 5 | | Cash Flow | (30,000) | 6,000 | 8,000 | 10,000 | 12,000 | 14,000 | 16,000 | 18,000 |
| 6 | | Present Value of Cash Flow | =C5/(1+$C2)^C4 | =D5/(1+$C2)^D4 | =E5/(1+$C2)^E4 | =F5/(1+$C2)^F4 | =G5/(1+$C2)^G4 | =H5/(1+$C2)^H4 | =I5/(1+$C2)^I4 | =J5/(1+$C2)^J4 |
| 7 | | | | | | | | | **NPV =** | **=SUM(C6:J6)** |
| 8 | | | | | | | | | **IRR =** | **=IRR(C5:J5)** |

**Figure 16.7 Function for Calculating IRR ($ except IRR/Cost of Funds)**

| | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | |
| 2 | **Company's Cost of Funds** | | **9%** | | | | | | | |
| 3 | | | | | | | | | | |
| 4 | | **Year** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| 5 | | Cash Flow | (30,000) | 6,000 | 8,000 | 10,000 | 12,000 | 14,000 | 16,000 | 18,000 |
| 6 | | Present Value of Cash Flow | (30,000) | 5,505 | 6,733 | 7,722 | 8,501 | 9,099 | 9,540 | 9,847 |
| 7 | | | | | | | | | **NPV =** | **26,947** |
| 8 | | | | | | | | | **IRR =** | **27.7%** |

**Figure 16.8 Final Spreadsheet ($ except IRR/Cost of Funds)**

## Using Excel to Create an NPV Profile

Firms often do not know exactly what their cost of attracting capital is, so they must use estimates in their decision-making. Also, the cost of attracting capital can change with economic and market conditions. Especially if markets are volatile, a company may use an NPV profile to see how sensitive their decisions are to changes in financing costs. Excel simplifies the creation of an NPV profile.

Middleton Manufacturing is considering installing solar panels to heat water and provide lighting throughout its plant. To do so will cost the company $800,000 this year. However, this upgrade will save the company an estimated $150,000 in electrical costs each year for the next 10 years. Constructing an NPV profile of this project will allow Middleton to see how the NPV of the project changes with the cost of attracting funds.

First, the project cash flows must be placed in an Excel spreadsheet, as is shown in cells D2 through N2 in Figure 16.9. The company's cost of funds is placed in cell B1; begin by putting in 10% for this rate. Next, the formula for NPV is placed in cell B6; cell B6 shows the NPV of the cash flows in cells D2 through N2, using the rate that is in cell B1.

For reference, compute IRR in cell B4. Calculating IRR is not necessary for creating the NPV profile. However, it gives a good reference point. Remember that if the IRR of a project is greater than the firm's cost of attracting capital, then the NPV will be positive; if the IRR of a project is less than the firm's cost of attracting capital, then the NPV will be negative.

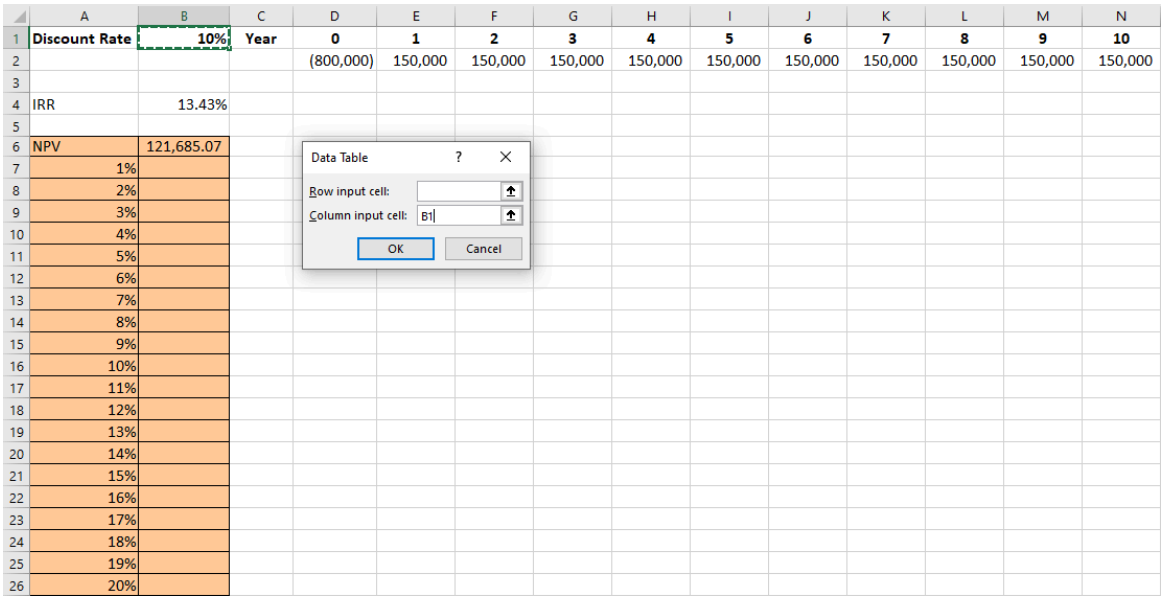
An NPV profile is created by calculating the NPV of the project for a variety of possible costs of attracting capital. In other words, you want to calculate NPV using the project cash flows in cells D2 through N2, using a variety of discount rates in cell B1. This is accomplished by using the Excel data table function. The data table function shows how the outcome of an Excel formula changes when one of the cells in the spreadsheet changes. In this instance, you want to determine how the value of the NPV formula (cell B6) changes when the discount rate (cell B1) changes.

| | A | B | C | D | E | F | G | H | I | J | K | L | M | N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **Discount Rate** | **10%** | **Year** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
| 2 | | | | (800,000) | 150,000 | 150,000 | 150,000 | 150,000 | 150,000 | 150,000 | 150,000 | 150,000 | 150,000 | 150,000 |
| 3 | | | | | | | | | | | | | | |
| 4 | IRR | 13.43% | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | |
| 6 | NPV | 121,685.07 | | | | | | | | | | | | |
| 7 | 1% | | | | | | | | | | | | | |
| 8 | 2% | | | | | | | | | | | | | |
| 9 | 3% | | | | | | | | | | | | | |
| 10 | 4% | | | | | | | | | | | | | |
| 11 | 5% | | | | | | | | | | | | | |
| 12 | 6% | | | | | | | | | | | | | |
| 13 | 7% | | | | | | | | | | | | | |
| 14 | 8% | | | | | | | | | | | | | |
| 15 | 9% | | | | | | | | | | | | | |
| 16 | 10% | | | | | | | | | | | | | |
| 17 | 11% | | | | | | | | | | | | | |
| 18 | 12% | | | | | | | | | | | | | |
| 19 | 13% | | | | | | | | | | | | | |
| 20 | 14% | | | | | | | | | | | | | |
| 21 | 15% | | | | | | | | | | | | | |
| 22 | 16% | | | | | | | | | | | | | |
| 23 | 17% | | | | | | | | | | | | | |
| 24 | 18% | | | | | | | | | | | | | |
| 25 | 19% | | | | | | | | | | | | | |
| 26 | 20% | | | | | | | | | | | | | |

**Figure 16.9 Project Cash Flows Inserted into Excel**

To do this, enter the range of interest rates that you want to consider down a column, beginning in cell A7. This example shows rates from 1% to 20% entered in cells A7 through A26. Your Excel file should now look like the screenshot in Figure 16.9.

Next, highlight the cells containing the NPV calculation and the range of discount rates. Thus, you will highlight cells A6 through A26 and B6 through B26 (see Figure 16.10). Click Data at the top of the Excel menu so that you see the What-If Analysis feature. Choose Data Table. Because the various discount rates you want to use are in a column, use the "Column input cell" option. Enter "B1" in this box. You are telling Excel to calculate NPV using each of the numbers in this column as the cost of attracting funds in cell B1. Click OK.




| | A | B | C | D | E | F | G | H | I | J | K | L | M | N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **Discount Rate** | **10%** | **Year** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
| 2 | | | | (800,000) | 150,000 | 150,000 | 150,000 | 150,000 | 150,000 | 150,000 | 150,000 | 150,000 | 150,000 | 150,000 |
| 3 | | | | | | | | | | | | | | |
| 4 | IRR | 13.43% | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | |
| 6 | NPV | 121,685.07 | | | | | | | | | | | | |
| 7 | 1% | | | | | | | | | | | | | |
| 8 | 2% | | | | | | | | | | | | | |
| 9 | 3% | | | | | | | | | | | | | |
| 10 | 4% | | | | | | | | | | | | | |
| 11 | 5% | | | | | | | | | | | | | |
| 12 | 6% | | | | | | | | | | | | | |
| 13 | 7% | | | | | | | | | | | | | |
| 14 | 8% | | | | | | | | | | | | | |
| 15 | 9% | | | | | | | | | | | | | |
| 16 | 10% | | | | | | | | | | | | | |
| 17 | 11% | | | | | | | | | | | | | |
| 18 | 12% | | | | | | | | | | | | | |
| 19 | 13% | | | | | | | | | | | | | |
| 20 | 14% | | | | | | | | | | | | | |
| 21 | 15% | | | | | | | | | | | | | |
| 22 | 16% | | | | | | | | | | | | | |
| 23 | 17% | | | | | | | | | | | | | |
| 24 | 18% | | | | | | | | | | | | | |
| 25 | 19% | | | | | | | | | | | | | |
| 26 | 20% | | | | | | | | | | | | | |

**Figure 16.10 Creating a Data Table in Excel**

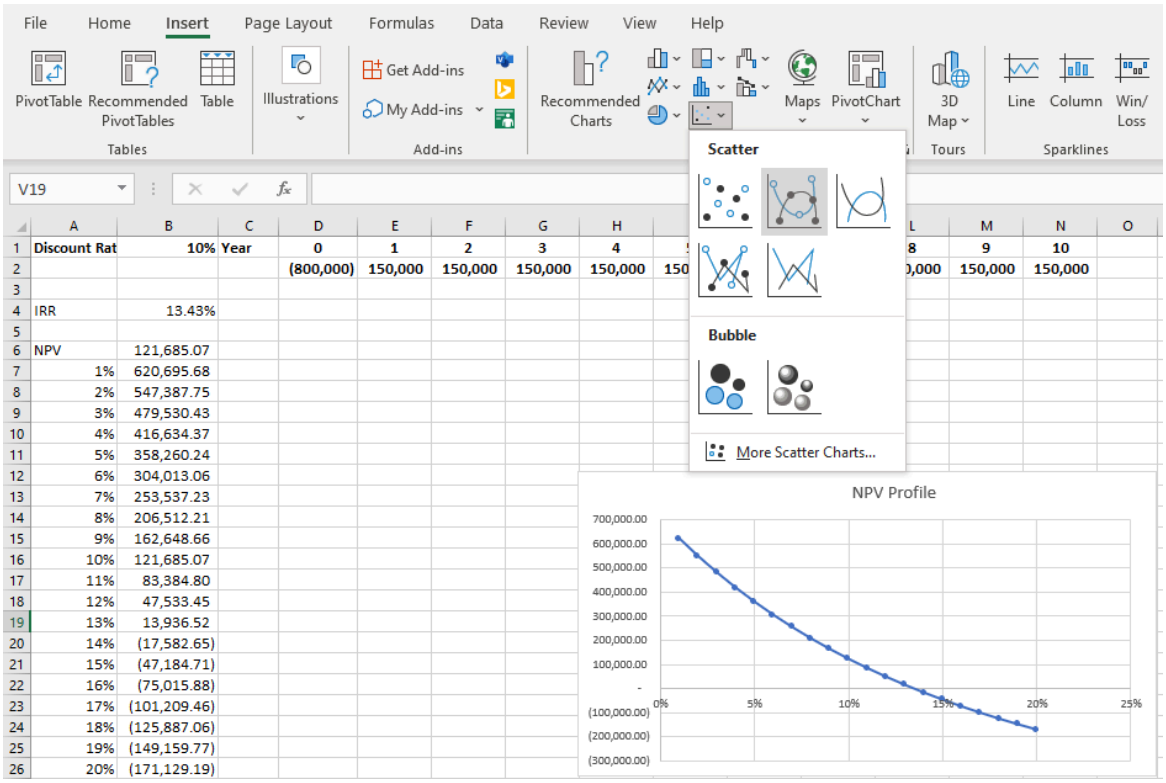
After clicking OK, the cells in column B next to the list of various discount rates will fill with the NPVs corresponding to each of the rates. This is shown in Figure 16.11.

| | A | B | C | D | E | F | G | H | I | J | K | L | M | N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **Discount Rate** | **10%** | **Year** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
| 2 | | | | (800,000) | 150,000 | 150,000 | 150,000 | 150,000 | 150,000 | 150,000 | 150,000 | 150,000 | 150,000 | 150,000 |
| 3 | | | | | | | | | | | | | | |
| 4 | IRR | 13.43% | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | |
| 6 | NPV | 121,685.07 | | | | | | | | | | | | |
| 7 | 1% | 620,695.68 | | | | | | | | | | | | |
| 8 | 2% | 547,387.75 | | | | | | | | | | | | |
| 9 | 3% | 479,530.43 | | | | | | | | | | | | |
| 10 | 4% | 416,634.37 | | | | | | | | | | | | |
| 11 | 5% | 358,260.24 | | | | | | | | | | | | |
| 12 | 6% | 304,013.06 | | | | | | | | | | | | |
| 13 | 7% | 253,537.23 | | | | | | | | | | | | |
| 14 | 8% | 206,512.21 | | | | | | | | | | | | |
| 15 | 9% | 162,648.66 | | | | | | | | | | | | |
| 16 | 10% | 121,685.07 | | | | | | | | | | | | |
| 17 | 11% | 83,384.80 | | | | | | | | | | | | |
| 18 | 12% | 47,533.45 | | | | | | | | | | | | |
| 19 | 13% | 13,936.52 | | | | | | | | | | | | |
| 20 | 14% | (17,582.65) | | | | | | | | | | | | |
| 21 | 15% | (47,184.71) | | | | | | | | | | | | |
| 22 | 16% | (75,015.88) | | | | | | | | | | | | |
| 23 | 17% | (101,209.46) | | | | | | | | | | | | |
| 24 | 18% | (125,887.06) | | | | | | | | | | | | |
| 25 | 19% | (149,159.77) | | | | | | | | | | | | |
| 26 | 20% | (171,129.19) | | | | | | | | | | | | |

**Figure 16.11 NPV Calculated for Various Discount Rates**

Now that the various NPVs are calculated, you can create the NPV profile graph. To create the graph, begin by highlighting the discount rates and NPVs that are in cells A7 through A26 and B7 through B26. Next, go to the Insert tab in the menu at the top of Excel. Several different chart options will be available; choose Scatter. You will end up with a chart that looks like the one in Figure 16.12. You can customize the chart by renaming it, labeling the axes, and making other cosmetic changes if you like.

You will notice that the NPV profile crosses the *x*-axis between 13% and 14%; remember that the NPV will be zero when the discount rate that is used to calculate the NPV is equal to the project's IRR, which we previously calculated to be 13.43%. If the firm's cost of raising funds is lower than 13.43%, the NPV profile shows that the project has a positive NPV, and the project should be accepted. Conversely, if the firm's cost of raising funds is greater than 13.43%, the NPV of this project will be negative, and the project should not be accepted.




| | A | B | C | D | E | F | G | H | L | M | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Discount Rat | 10% | Year | 0 | 1 | 2 | 3 | 4 | 8 | 9 | 10 | |
| 2 | | | | (800,000) | 150,000 | 150,000 | 150,000 | 150,000 | ,000 | 150,000 | 150,000 | |
| 3 | | | | | | | | | | | | |
| 4 | IRR | 13.43% | | | | | | | | | | |
| 5 | | | | | | | | | | | | |
| 6 | NPV | 121,685.07 | | | | | | | | | | |
| 7 | 1% | 620,695.68 | | | | | | | | | | |
| 8 | 2% | 547,387.75 | | | | | | | | | | |
| 9 | 3% | 479,530.43 | | | | | | | | | | |
| 10 | 4% | 416,634.37 | | | | | | | | | | |
| 11 | 5% | 358,260.24 | | | | | | | | | | |
| 12 | 6% | 304,013.06 | | | | | | | | | | |
| 13 | 7% | 253,537.23 | | | | | | | | | | |
| 14 | 8% | 206,512.21 | | | | | | | | | | |
| 15 | 9% | 162,648.66 | | | | | | | | | | |
| 16 | 10% | 121,685.07 | | | | | | | | | | |
| 17 | 11% | 83,384.80 | | | | | | | | | | |
| 18 | 12% | 47,533.45 | | | | | | | | | | |
| 19 | 13% | 13,936.52 | | | | | | | | | | |
| 20 | 14% | (17,582.65) | | | | | | | | | | |
| 21 | 15% | (47,184.71) | | | | | | | | | | |
| 22 | 16% | (75,015.88) | | | | | | | | | | |
| 23 | 17% | (101,209.46) | | | | | | | | | | |
| 24 | 18% | (125,887.06) | | | | | | | | | | |
| 25 | 19% | (149,159.77) | | | | | | | | | | |
| 26 | 20% | (171,129.19) | | | | | | | | | | |

**Figure 16.12 NPV Profile Created Using Excel**

Middleton Manufacturing can use this NPV profile to evaluate its solar panel installation project. If the managers think that the cost of attracting funds for the company is 10%, then the project has a positive NPV of $121,685 and the company should install the panels. The NPV profile shows that if the managers are underestimating the cost of funds even by 30% and it will really cost Middleton 13% to attract funds, the project is still a good project. The cost of attracting funds would have to be higher than 13.43% for the solar panel project to be rejected.

# Summary

## 16.1 Payback Period Method

The payback period is the simplest project evaluation method. It is the time it takes the company to recoup its initial investment. Its usefulness is limited, however, because it ignores the time value of money.

## 16.2 Net Present Value (NPV) Method

Net present value (NPV) is calculated by subtracting the present value of a project's cash outflows from the present value of the project's cash inflows. A project should be accepted if its NPV is positive and rejected if its NPV is negative.

## 16.3 Internal Rate of Return (IRR) Method

The internal rate of return (IRR) of a project is the discount rate that sets the present value of a project's cash inflows exactly equal to the present value of the project's cash outflows. A project should be accepted if its IRR is greater than the firm's cost of attracting capital.

## 16.4 Alternative Methods

The discounted payback period uses the time value of money to discount future cash flows to see how long it will be before the initial investment of a project is recovered. MIRR provides a variation on IRR in which all cash flows are compounded using the cost of capital, resolving the reinvestment rate assumption problem of the IRR method; unlike IRR, which may have multiple mathematical solutions, MIRR will result in one solution. The profitability index is calculated as the NPV of the project divided by the initial cost of the project.

## 16.5 Choosing between Projects

Firms may need to choose among a variety of good projects. The projects may have different lives or be differently sized projects that require different amounts of resources. By choosing projects with the highest profitability index, companies can take on the projects that will lead to the greatest increase in value for the company.

## 16.6 Using Excel to Make Company Investment Decisions

Excel spreadsheets provide a way to easily calculate the NPV and IRR of a project. Using Excel to create an NPV profile allows a company to see how much its estimates of the cost of raising funds can err from the true cost and have the project still be an acceptable project.

# Key Terms

**capital budgeting** the process a business follows to evaluate potential major projects or investments

**discounted payback period** the length of time it will take for the present value of the future cash inflows of a project to equal the initial cost of the investment

**equal annuity approach** a method of comparing projects of different lives by assuming that the projects can be repeated forever

**internal rate of return (IRR)** the discount rate that sets the NPV of a project equal to zero

**modified internal rate of return (MIRR)** the yield that sets the future value of the cash inflows of a project equal to the present value of the cash outflows of the project

**mutually exclusive projects** projects that compete against each other so that when one project is chosen, the other project cannot be done

**net present value (NPV)** the present value of the cash inflows of a project minus the present value of the cash outflows of the project

**payback period** the length of time it will take for a company to make enough money from an investment to recover the initial cost of the investment

**profitability index (PI)** the present value of cash inflows divided by the present value of cash outflows
**replacement chain approach** a method of comparing projects of differing lives by repeating shorter projects multiple times until they reach the lifetime of the longest project

## CFA Institute

This chapter supports some of the Learning Outcome Statements (LOS) in this CFA® Level I Study Session (https://openstax.org/r/cfa-level-i-study-session). Reference with permission of CFA Institute.

## Multiple Choice

1. Which of the following is a disadvantage of using the payback method?
   **a.** It only considers cash flows that occur after the project breaks even.
   **b.** It ignores the time value of money.
   **c.** It is difficult to calculate.
   **d.** You must know the company's cost of raising funds to be able to use it.

2. A company should accept a project if _____.
   **a.** the NPV of the project is positive
   **b.** the NPV of the project is negative
   **c.** the IRR of the project is positive
   **d.** the IRR of the project is negative

3. The net present value of a project equals _____.
   **a.** the future value of the cash inflows minus the future value of the cash outflows
   **b.** the present value of the cash inflows minus the future value of the cash outflows
   **c.** the present value of the cash inflows minus the present value of the cash outflows
   **d.** the future value of the cash inflows minus the present value of the cash outflows

4. The IRR of a project is the discount rate that _____.
   **a.** makes the NPV equal to zero
   **b.** equates the present value of the cash inflows to the future value of the cash outflows
   **c.** makes the NPV positive
   **d.** equates the present value of cash outflows to the future value of the cash inflows

5. The IRR method assumes that _____.
   **a.** cash flows are reinvested at the firm's cost of attracting funds when they are received
   **b.** cash flows of a project are never reinvested
   **c.** cash flows are reinvested at the internal rate of return when they are received
   **d.** the NPV of a project is negative

6. When cash outflows occur during more than one time period, _____.
   **a.** the project's NPV will definitely be negative
   **b.** the project can have multiple IRRs
   **c.** the project should not be done
   **d.** the time value of money is not important

7. The discounted payback period method _____.
   **a.** is used to compare two projects that have different lives
   **b.** fails to consider the time value of money
   **c.** provides an objective criterion for an accept-or-reject decision grounded in financial theory
   **d.** discounts cash flows using the company's cost of funds to overcome a flaw of the payback period method

8. Which of the following is a method of adjustment for comparing projects of different lives?

**a.** IRR
**b.** Modified IRR
**c.** Payback period
**d.** Equal annuity

**9.** When a company can only fund some of its good projects, it should rank the projects by _____.
**a.** PI
**b.** IRR
**c.** NPV
**d.** payback period

**10.** If a company is considering two mutually exclusive projects, which of the following statements is true?
**a.** The company must do both projects if it chooses to do one of the projects.
**b.** The IRR method should be used to compare the projects.
**c.** Doing one of the projects means the other project cannot be done.
**d.** The company does not need to compare the projects because it can choose to do both.

## Review Questions

1. Describe the disadvantages of using the payback period to evaluate a project.
2. Explain why a company would want to accept a project with a positive NPV and reject a project with a negative NPV.
3. Westland Manufacturing could spend $5,000 to update its existing fluorescent lighting fixtures to newer fluorescent fixtures that would be more energy efficient. Explain why updating the light fixtures with newer fluorescent fixtures and replacing the existing fixtures with LED fixtures would be considered mutually exclusive projects.
4. When faced with a decision between two good but mutually exclusive projects, should a manager base the decision on NPV or IRR? Why?

## Problems

1. Westland Manufacturing spends $20,000 to update the lighting in its factory to more energy-efficient LED fixtures. This will save the company $4,000 per year in electricity costs. What is the payback period of this project?
2. Westland Manufacturing spends $20,000 to update the lighting in its factory to more energy-efficient LED fixtures. This will save the company $4,000 per year in electricity costs. The company estimates that these fixtures will last for 10 years. If the company's cost of funds is 8%, what is the NPV of this project?
3. If Westland Manufacturing finds that its cost of funds is 11%, what will happen to the NPV of the project in problem 2?
4. Westland Manufacturing spends $20,000 to update the lighting in its factory to more energy-efficient LED fixtures. This will save the company $4,000 per year in electricity costs. The company estimates that these fixtures will last for 10 years. What is the IRR of this project?
5. Westland Manufacturing spends $20,000 to update the lighting in its factory to more energy-efficient LED fixtures. This will save the company $4,000 per year in electricity costs. The company estimates that these fixtures will last for 10 years. If the company's cost of funds is 8%, what is the PI of this project?
6. Westland Manufacturing spends $20,000 to update the lighting in its factory to more energy-efficient LED fixtures. This will save the company $4,000 per year in electricity costs. The company estimates that these fixtures will last for 10 years. If the company's cost of funds is 8%, what is the modified IRR of this project?

7. Westland Manufacturing spends $20,000 to update the lighting in its factory to more energy-efficient LED fixtures. This will save the company $4,000 per year in electricity costs. The company estimates that these fixtures will last for 10 years. If the company's cost of funds is 8%, what is the discounted payback period of this project?
8. Holiday Hotels is considering two different floorings to use in its buildings. The less expensive tile will need to be replaced every five years. The more durable, more expensive tile will need to be replaced every eight years. To use the replacement chain approach to compare these two projects, how many times would you have to assume each type of tile would be replaced?
9. You will be living in your college town for two more years. You are considering purchasing a townhouse that will cost you $250,000 today. You estimate that if you do, your expenses for each of the next two years will be $6,000 less than if you rented an apartment. You think that you would be able to lease the townhouse to another college student afterward for $12,000 per year and that your taxes, maintenance, and other expenses for the townhouse would be $5,000 per year. You expect to lease the townhouse for five years before you sell it, and you expect to be able to sell the townhouse for $275,000. Use Excel to create an NPV profile for this undertaking. If it will cost you 3% to borrow money, should you buy the townhouse? What if it will cost you 8% to borrow money?

## Video Activity

### Calculating NPV and IRR

Access multimedia content (http://openstax.org/books/principles-finance/pages/16-video-activity)

Businesses use NPV and IRR to determine whether or not a project will add value for shareholders. Watch this CFA® Level I Corporate Finance video to learn more. Working along with the video, you will gain practice in using your financial calculator to calculate IRR.

1. According to the video, how should a company use NPV and IRR to decide whether a project should be undertaken?
2. In the video, Trim Corp. is considering a project that is expected to have cash inflows of $350, $250, and $150 in years 1, 2, and 3, respectively. What do you think would happen to the NPV of the project if the company expected the same cash flows, but in reverse order? In other words, what do you think would happen to the NPV if the $150 were the cash inflow of year 1, $250 were the cash inflow for year 2, and $350 were the cash inflow for year 3? Using the same discount rate as in the video, 25%, calculate the NPV for the project with this string of cash outflows. Was the outcome what you thought it would be?

### The Tokyo Olympics

Access multimedia content (http://openstax.org/books/principles-finance/pages/16-video-activity)

The capital investment a city must undertake to host the Olympic Games is massive. Learn more about the capital investments and expenses Tokyo faced as host of the 2020 Summer Olympics and how it was impacted by a global pandemic by watching this video, How the Tokyo Olympics Became the Most Expensive Summer Games Ever.

3. Given the costs discussed in the video, create an Excel spreadsheet to estimate the NPV and IRR of hosting the Olympic Games for a city.
4. How would the numbers in your Excel spreadsheet change because of the COVID-19 pandemic? Create an NPV profile for Tokyo's Olympic Games given the changes that were caused by the pandemic.

17

# How Firms Raise Capital

**Figure 17.1** A company can only attract capital if it offers an expected return that is competitive with other options. (credit: modification of "1166357_33949449" by Jenifer Corrêa/flickr, CC BY 2.0)

## Chapter Outline


**17.1** The Concept of Capital Structure
**17.2** The Costs of Debt and Equity Capital
**17.3** Calculating the Weighted Average Cost of Capital
**17.4** Capital Structure Choices
**17.5** Optimal Capital Structure
**17.6** Alternative Sources of Funds


## Why It Matters

The most important job that company managers have is to maximize the value of the company. Some obvious things come to mind when you think of how managers would do this. For example, to maximize the value of American Airlines, the managers need to attract customers and sell seats on flights. They also need to keep costs as low as possible, which means keeping the costs of purchasing fuel and making plane repairs as low as possible. While the concept of keeping costs low is simple, the specific decisions a firm makes can be complex. If American Airlines wants to purchase a new airplane, it needs to consider not just the dollar cost of the initial purchase but also the passenger and cargo capacity of the plane as well as ongoing maintenance costs.

In addition to paying salaries to its pilots and flight attendants, American Airlines must pay to use investors' money. If the company wants to purchase a new airplane, it may borrow money to pay for the plane. Even if American Airlines does not need to incur debt to buy the plane, the money it uses to buy the plane ultimately belongs to the owners or shareholders of the company. The company must consider the opportunity cost of this money and the return that shareholders are expecting on their investments.

Just as different planes have distinctive characteristics and costs, the different types of financing that American Airlines can use will have different characteristics and costs. One of the tasks of the financial manager is to consider the trade-offs of these sources of funding. In this chapter, we look at the basic principles that managers use to minimize the cost of funding and maximize the value of the firm.

# 17.1 The Concept of Capital Structure

By the end of this section, you will be able to:

- Distinguish between the two major sources of capital appearing on a balance sheet.
- Explain why there is a cost of capital.
- Calculate the weights in a company's capital structure.

## The Basic Balance Sheet

In order to produce and sell its products or services, a company needs assets. If a firm will produce shirts, for example, it will need equipment such as sewing machines, cutting boards, irons, and a building in which to store its equipment. The company will also need some raw materials such as fabric, buttons, and thread. These items the company needs to conduct its operations are *assets*. They appear on the left-hand side of the balance sheet.

The company has to pay for these assets. The sources of the money the company uses to pay for these assets appear on the right-hand side of the balance sheet. The company's sources of financing represent its **capital**. There are two broad types of capital: debt (or borrowing) and equity (or ownership).

Figure 17.2 is a representation of a basic balance sheet. Remember that the two sides of the balance sheet must be $\text{Assets} = \text{Liabilities} + \text{Equity}$. Companies typically finance their assets through equity (selling ownership shares to stockholders) and debt (borrowing money from lenders). The debt that a firm uses is often referred to as **financial leverage**. The relative proportions of debt and equity that a firm uses in financing its assets is referred to as its **capital structure**.

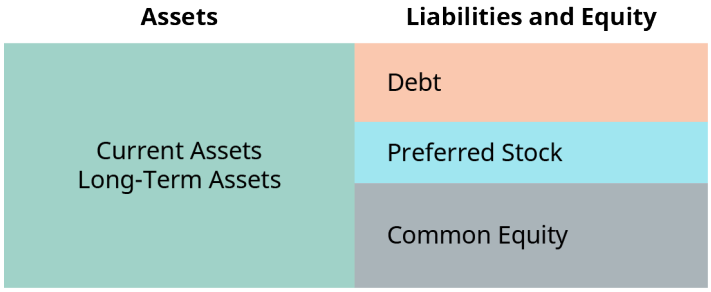



**Figure 17.2 Basic Balance Sheet for Company with Debt, Preferred Stock, and Common Equity in Capital Structure**

## Attracting Capital

When a company raises money from investors, those investors forgo the opportunity to invest that money elsewhere. In economics terms, there is an *opportunity cost* to those who buy a company's bonds or stock.

Suppose, for example, that you have $5,000, and you purchase Tesla stock. You could have purchased Apple stock or Disney stock instead. There were many other options, but once you chose Tesla stock, you no longer had the money available for the other options. You would only purchase Tesla stock if you thought that you would receive a return as large as you would have for the same level of risk on the other investments.

From Tesla's perspective, this means that the company can only attract your capital if it offers an expected return high enough for you to choose it as the company that will use your money. Providing a return equal to what potential investors could expect to earn elsewhere for a similar risk is the cost a company bears in exchange for obtaining funds from investors. Just as a firm must consider the costs of electricity, raw materials, and wages when it calculates the costs of doing business, it must also consider the cost of attracting capital so that it can purchase its assets.

## Weights in the Capital Structure

Most companies have multiple sources of capital. The firm's overall cost of capital is a weighted average of its

debt and equity costs of capital. The average of a firm's debt and equity costs of capital, weighted by the fractions of the firm's value that correspond to debt and equity, is known as the **weighted average cost of capital (WACC)**.

The weights in the WACC are the proportions of debt and equity used in the firm's capital structure. If, for example, a company is financed 25% by debt and 75% by equity, the weights in the WACC would be 25% on the debt cost of capital and 75% on the equity cost of capital. The balance sheet of the company would look like Figure 17.3.

These weights can be derived from the right-hand side of a market-value-based balance sheet. Recall that accounting-based book values listed on traditional financial statements reflect historical costs. The market-value balance sheet is similar to the accounting balance sheet, but all values are current market values.

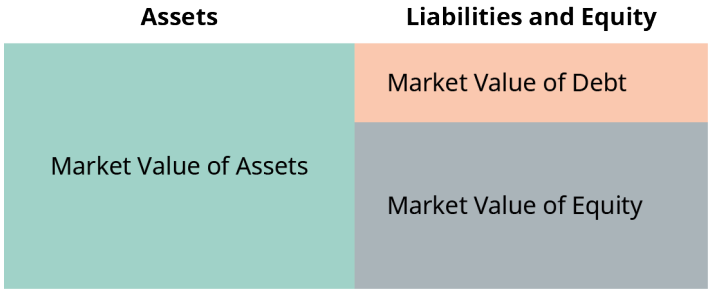



**Figure 17.3 Balance Sheet of Company with Capital Structure of 25% Debt and 75% Equity**

Just as the accounting balance sheet must balance, the market-value balance sheet must balance:

$$\text{Market Value of Assets} = \text{Market Value of Debt} + \text{Market Value of Equity} \quad \textbf{17.1}$$

This equation reminds us that the values of a company's debt and equity flow from the market value of the company's assets.

Let's look at an example of how a company would calculate the weights in its capital structure. Bluebonnet Industries has debt with a book (face) value of $5 million and equity with a book value of $3 million. Bluebonnet's debt is trading at 97% of its face value. It has one million shares of stock, which are trading for $15 per share.

First, the market values of the company's debt and equity must be determined. Bluebonnet's debt is trading at a discount; its market value is $0.97 \times \$5{,}000{,}000 = \$4{,}850{,}000$. The market value of Bluebonnet's equity equals $\text{Number of Shares} \times \text{Price per Share} = 1{,}000{,}000 \times \$15 = \$15{,}000{,}000$. Thus, the total market value of the company's capital is $\$4{,}850{,}000 + \$15{,}000{,}000 = \$19{,}850{,}000$. The weight of debt in Bluebonnet's capital structure is $\frac{\$4{,}850{,}000}{\$19{,}850{,}000} = 24.4\%$. The weight of equity in its capital structure is $\frac{\$15{,}000{,}000}{\$19{,}850{,}000} = 75.6\%$.

## 17.2 The Costs of Debt and Equity Capital

By the end of this section, you will be able to:

- Calculate the after-tax cost of debt capital.
- Explain why the return to debt holders is not the same as the cost to the firm.
- Calculate the cost of equity capital.

The costs of debt and equity capital are what company lenders (those who allow the firm to use their capital) expect in return for providing that capital. Just as current market values of debt and equity should be used in determining their weights in the capital structure, current market values of debt and equity should be used in determining the costs of those types of financing.

## Cost of Debt Capital

A company's cost of debt is the interest rate it would have to pay to refinance its existing debt. Because a firm's existing debt trades in the marketplace, its price changes according to market conditions. The overall credit environment can change due to changing macroeconomic conditions, causing a change in the price of debt securities. In addition, as there are changes in the overall riskiness of the firm and its ability to repay its creditors, the price of the debt securities issued by the firm will change.

The market price of a company's existing bonds implies a yield to maturity. Recall that the *yield to maturity* is the return that current purchasers of the debt will earn if they hold the bond to maturity and receive all of the payments promised by the borrowing firm.

### Yield to Maturity and the Cost of Debt

Bluebonnet's debt is selling for 97% of its face value. This means that for every $100 of face value, investors are currently paying $97 for an outstanding bond issued by Bluebonnet Industries. This debt has a coupon rate of 6%, paid semiannually, and the bonds mature in 15 years.

Because the bonds are selling at a discount, the yield that investors who purchase these bonds will receive if they hold the bond to maturity exceeds 6%. The purchasers of these bonds will receive a coupon payment of $\$100 \times \frac{0.06}{2} = \$3$ every six months for the next 15 years. They will also receive the $100 face value when the bonds mature in 15 years. To calculate the yield to maturity of these bonds using your financial calculator, input the information shown in Table 17.1.

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 1 | Enter number of coupon payments | 30 N | N = | 30.00 |
| 2 | Enter the price paid for the bond | 97 +/− PV | PV = | -97.00 |
| 3 | Enter the coupon payment | 3 PMT | PMT = | 3.00 |
| 4 | Enter the face value of the bond | 100 FV | FV = | 100.00 |
| 5 | Compute the semiannual rate | CPT I/Y | I/Y = | 3.156 |
| 6 | Multiply 3.156 by 2 to get YTM | × 2 = | | 6.312 |

**Table 17.1 Calculator Steps for Finding the Yield to Maturity**[1]

The yield to maturity (YTM) of Bluebonnet Industries bonds is 6.312%. This YTM should be used in estimating the firm's overall cost of capital, not the coupon rate of 6% that is stated on the outstanding bonds. The coupon rate on the existing bonds is a historical rate, set under economic conditions that may have been different from the current market conditions. The YTM of 6.312% represents what investors are currently requiring to purchase the debt issued by the company.

### After-Tax Cost of Debt

Although current debt holders demand to earn 6.312% to encourage them to lend to Bluebonnet Industries, the cost to the firm is less than 6.312%. This is because interest paid on debt is a tax-deductible expense. When a firm borrows money, the interest it pays is offset to some extent by the tax savings that occur because of this deductible expense.

The **after-tax cost of debt** is the net cost of interest on a company's debt after taxes. This after-tax cost of debt is the firm's effective cost of debt. The after-tax cost of debt is calculated as $r_d(1 - T)$, where $r_d$ is the before-tax cost of debt, or the return that the lenders receive, and $T$ is the company's tax rate. If Bluebonnet

1 The specific financial calculator in these examples is the Texas Instruments BA II Plus™ Professional model, but you can use other financial calculators for these types of calculations.

Industries has a tax rate of 21%, then the firm's after-tax cost of debt is $6.312\%\ (1\ -\ 0.21)\ =\ 4.986\%$.

This means that for every $1,000 Bluebonnet borrows, the company will have to pay its lenders $1{,}000(6.312\%)\ =\ \$63.12$ in interest every year. The company can deduct $63.12 from its income, so this interest payment reduces the taxes the company must pay to the government by $\$63.12\ (0.21)\ =\ \$13.26\%$. Thus, Bluebonnet's effective cost of debt is $\$63.12\ -\ \$13.26\ =\ \$49.86$, or $\frac{\$49.86}{\$1{,}000} = 4.986\%$.

THINK IT THROUGH

### Calculating the After-Tax Cost of Debt

Royer Roasters has issued bonds that will mature in 18 years. The bonds have a coupon rate of 8%, and coupon payments are made semiannually. These bonds are currently selling at a price of $102.20 per $100 face value. Royer's tax rate is 28%. What is Royer's after-tax cost of debt?

**Solution:**

The purchasers of these bonds will receive a coupon payment of $\$100\ \times\ \frac{0.08}{2} = \$4$ every six months for the next 18 years. The owners of the bonds will also receive the $100 face value when the bonds mature in 18 years. To calculate the yield to maturity of these bonds, input the information in Table 17.2 in your financial calculator.

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 1 | Enter number of coupon payments | 36 N | N = | 36.00 |
| 2 | Enter the price paid for the bond | 102.20 +/− PV | PV = | -102.20 |
| 3 | Enter the coupon payment | 4 PMT | PMT = | 4.00 |
| 4 | Enter the face value of the bond | 100 FV | FV = | 100.00 |
| 5 | Compute the semiannual rate | CPT I/Y | I/Y = | 3.885 |
| 6 | Multiply 3.885 by 2 to get YTM | × 2 = | | 7.771 |

**Table 17.2 Calculator Steps to Find Bond Yield to Maturity**

The bondholders require 7.771% to entice them to purchase the debt issued by the company. Royer Roasters is able to deduct interest expenses before taxes. Thus, its after-tax cost of debt is $7.771\%\ \times\ (1\ -\ 0.28)\ =\ 5.595\%$.

## Cost of Equity Capital

Companies can raise money by selling stock, or ownership shares, of the company. Stock is known as equity capital. The cost of common stock capital cannot be directly observed in the market; it must be estimated. Two primary methods for estimating the cost of common stock capital are the capital asset pricing model (CAPM) and the constant dividend growth model.

### CAPM

The CAPM is based on using the firm's systematic risk to estimate the expected returns that shareholders require to invest in the stock. According to the CAPM, the cost of equity ($r_e$) can be estimated using the formula

$$r_e\ =\ \text{Risk-Free Rate}\ +\ (\text{Equity Beta}\ \times\ \text{Market Risk Premium}) \tag{17.2}$$

For example, suppose that Bluebonnet Industries has an equity beta of 1.3. Because the beta is greater than one, the stock has more systematic risk than the average stock in the market. Assume that the rate on 10-year

US Treasury notes is 3% and serves as a proxy for the risk-free rate. If the long-run average return for the stock market is 11%, the market risk premium is $11\% - 3\% = 8\%$; this means that people who invest in the stock market are rewarded for the risk they are taking by being paid 8% more than they would have been paid if they had purchased US Treasury notes. Bluebonnet Industries cost of equity capital can be estimated as

$$r_e = 0.03 + (1.3 \times 0.08) = 0.03 + 0.104 = 0.134 = 13.4\% \quad \textbf{17.3}$$

### Constant Dividend Growth Model

The constant dividend growth model provides an alternative method of calculating a company's cost of equity. The basic formula for the constant dividend growth model is

$$r_e = \frac{\text{Dividend in One Year}}{\text{Current Stock Price}} + \text{Dividend Growth Rate} = \frac{Div_1}{P_0} + g \quad \textbf{17.4}$$

Thus, three things are needed to complete this calculation: the current stock price, what the dividend will be in one year, and the growth rate of the dividend. The current price of the stock is easy to obtain by looking at the financial news. The other two items, the dividend next year and the growth rate of the dividend, will occur in the future and at the current time are not known with certainty; these two items must be estimated.

Suppose Bluebonnet paid a dividend of $1.50 per share to its shareholders last year. Also suppose that this dividend has been growing at a rate of 2% each year for the past several years and that growth rate is expected to continue into the future. Then, the dividend in one year can be expected to be $\$1.50(1 + 0.02) = \$1.53$. If the current stock price is $12.50 per share, then that cost of equity is estimated as

$$r_e = \frac{\$1.53}{\$12.50} + 0.02 = 0.1224 + 0.02 = 0.1424 = 14.24\% \quad \textbf{17.5}$$

**THINK IT THROUGH**

#### Using the Constant Dividend Growth Model

What does an increase in the price of a company's stock imply about the equity cost of capital for the company? To find out what the constant dividend growth model suggests, assume that the stock price for Bluebonnet Industries increases to $16.50 per share. If there is no expectation that the growth rate of the dividends will increase, what would the new estimated equity cost of capital be?

**Solution:**

Using the price of $16.50 per share in the constant dividend growth model equation results in an estimated equity cost of capital of

$$r_e = \frac{\$1.53}{\$16.50} + 0.02 = 0.0927 + 0.02 = 0.1127 = 11.27\% \quad \textbf{17.6}$$

Thus, an increase in the price of the stock, holding all of the other variables in the equation constant, implies that the equity cost of capital drops to 11.27%.

## 17.3 Calculating the Weighted Average Cost of Capital

By the end of this section, you will be able to:

- Calculate the weighted average cost of capital (WACC).
- Describe issues that arise from estimating the cost of equity capital.
- Describe the use of net debt in calculating WACC.

Once you know the weights in a company's capital structure and have estimated the costs of the different sources of its capital, you can calculate the company's weighted average cost of capital (WACC).

## WACC Equation

WACC is calculated using the equation

$$\text{WACC} = D\% \times r_{\text{d}}(1 - T) + P\% \times r_{\text{pfd}} + E\% \times r_{\text{e}} \quad \textbf{17.7}$$

*D%*, *P%*, and *E%* represent the weight of debt, preferred stock, and common equity, respectively, in the capital structure. Note that $D\% + P\% + E\%$ must equal 100% because the company must account for 100% of its financing. The after-tax cost of debt is $r_{\text{d}}(1 - T)$. The cost of preferred stock capital is represented by $r_{\text{pfd}}$, and the cost of common stock capital is represented by $r_{\text{e}}$.

For a company that does not issue preferred stock, *P%* is equal to zero, and the WACC equation is simply

$$\text{WACC} = D\% \times r_{\text{d}}(1 - T) + E\% \times r_{\text{e}} \quad \textbf{17.8}$$

Earlier in this chapter, we calculated the weights in Bluebonnet Industries' capital structure to be $D\% = 24.4\%$ and $E\% = 75.6\%$. We also calculated the after-tax cost of debt for Bluebonnet to be 4.99%. If we use the CAPM to estimate the cost of equity capital for the firm, Bluebonnet's WACC is computed as

$$\text{WACC} = 24\% \times 4.99\% + 75.6\% \times 13.4\% = 1.20\% + 10.13\% = 11.33\% \quad \textbf{17.9}$$

If we use the constant dividend discount model to estimate the cost of equity for Bluebonnet Industries, the WACC is computed as

$$\text{WACC} = 24\% \times 4.99\% + 75.6\% \times 14.24\% = 1.20\% + 10.77\% = 11.97\% \quad \textbf{17.10}$$

## Calculating WACC in Practice

The equation for calculating WACC is straightforward. However, issues come up when financial managers calculate WACC in practice. Both the weights of the equity components and the cost of the equity components are needed to calculate the WACC. The WACC that financial managers derive will depend on the assumptions and models they use to determine what weights and capital costs to use.

### Issues in Estimating the Cost of Equity Capital

We have explored two ways of estimating the cost of equity capital: the CAPM and the constant dividend growth model. Often, these methods will produce similar estimates of the cost of capital; seldom will the two methods provide the same value.

In our example for Bluebonnet Industries, the CAPM estimated the cost of equity capital as 13.4%. The constant dividend growth model estimated the cost of capital as 14.24%. The exact value of the WACC calculation depends on which of these estimates is used. It is important to remember that the WACC is an estimate that is based on a number of assumptions that financial managers made.

For example, using the CAPM requires assumptions be made regarding the values of the risk-free interest rate, the market risk premium, and a firm's beta. The risk-free interest rate is generally determined using US Treasury security yields. In theory, the yield on US Treasury securities that have a maturity equivalent to the length of the company's investors' investment horizon should be used. It is common for financial analysts to use yields on long-term US Treasury bonds to determine the risk-free rate.

To estimate the market risk premium, analysts turn to historical data. Because this historical data is used to estimate the future market risk premium, the question arises of how many years of historical data should be used. Using more years of historical data can lead to more accurate estimates of what the average past return has been, but very old data may have little relevance if today's financial market environment is different from what it was in the past. Old data may have little relevance for investors' expectations today. Typical market risk premiums used by financial managers range from 5% to 8%.

The same issue with how much historical data should be considered arises when calculating a company's beta. Different financial managers can calculate significantly different betas even for well-established, stable companies. In April 2021, for example, the beta for IBM was reported as 0.97 by MarketWatch and as 1.25 by Yahoo! Finance.

The CAPM estimate of the cost of equity capital for IBM is significantly different depending on what source is used for the company's beta and what value is used for the market risk premium. Using a market risk premium of 5%, the beta of 0.97 provided by MarketWatch, and a risk-free rate of 3% results in a cost of capital of

$$r_e = 0.03 + (0.97 \times 0.05) = 0.03 + 0.0485 = 0.0785 = 7.85\% \quad \textbf{17.11}$$

If, instead, a market risk premium of 8% and the beta of 1.25 provided by Yahoo! Finance are used, the cost of capital is estimated to be

$$r_e = 0.03 + (1.25 \times 0.08) = 0.03 + 0.10 = 0.13 = 13.0\% \quad \textbf{17.12}$$

## CONCEPTS IN PRACTICE

### Estimating the Equity Cost of Capital

Although the calculation of the cost of capital using the CAPM equation is simple and straightforward, there is not one definitive equity cost of capital for a company that all financial managers will agree on. Consider the eight companies spotlighted in Table 17.3.

Four estimates of the equity cost of capital are calculated for each firm. The first two estimates are based on the beta provided by MarketWatch for each of the companies. A risk-free rate of 3% is assumed. Market risk premiums of both 5% and of 8% are considered. A market risk premium of 5% would suggest that long-run investors who hold a well-diversified portfolio, such as one with all of the stocks in the S&P 500, will average a return 5 percentage points higher than the risk-free rate, or 8%. If you assume instead that the average long-run return on the S&P 500 is 11%, then people who purchase a portfolio of those stocks are rewarded by earning 8 percentage points more than the 3% they would earn investing in the risk-free security.

The last two estimates of the cost of equity capital for each company also use the same risk-free rate of 3% and the possible market risk premiums of 5% and 8%. The only difference is that the beta provided by Yahoo! Finance is used in the calculation.

| Company | Industry | MarketWatch | | | Yahoo! Finance | | |
|---|---|---|---|---|---|---|---|
| | | Beta | MRP = 5% | MRP = 8% | Beta | MRP = 5% | MRP = 8% |
| Kroger | Food retail | 0.31 | 4.55% | 5.48% | 0.66 | 6.30% | 8.28% |
| Coca-Cola | Nonalcoholic beverages | 0.69 | 6.45% | 8.52% | 0.62 | 6.10% | 7.96% |
| AT&T | Telecommunications | 0.74 | 6.70% | 8.92% | 0.74 | 6.70% | 8.92% |
| Kraft Heinz | Food products | 0.82 | 7.10% | 9.56% | 1.14 | 8.70% | 12.12% |
| Microsoft | Software | 1.19 | 8.95% | 12.52% | 0.79 | 6.95% | 9.32% |
| Goodyear Tire and Rubber | Tires | 1.24 | 9.20% | 12.92% | 2.26 | 14.30% | 21.08% |

**Table 17.3 Estimates of Equity Cost of Capital for Eight Companies** (source: Yahoo! Finance; MarketWatch)

| Company | Industry | MarketWatch | | | Yahoo! Finance | | |
|---|---|---|---|---|---|---|---|
| | | Beta | MRP = 5% | MRP = 8% | Beta | MRP = 5% | MRP = 8% |
| American Airlines | Passenger airlines | 1.34 | 9.70% | 13.72% | 1.93 | 12.65% | 18.44% |
| KB Homes | Residential construction | 1.42 | 10.10% | 14.36% | 1.83 | 12.15% | 17.64% |

**Table 17.3 Estimates of Equity Cost of Capital for Eight Companies** (source: Yahoo! Finance; MarketWatch)

The range of the equity cost of capital estimates for each of the firms is significant. Consider, for example, Goodyear Tire and Rubber. According to MarketWatch, the beta for the company is 1.24, resulting in an estimated cost of equity capital between 9.20% and 12.92%. The beta provided by Yahoo! Finance is much higher, at 2.26. Using this higher beta results in an estimated equity cost of capital for Goodyear Tire and Rubber between 14.30% and 21.08%. This leaves the financial managers of Goodyear Tire and Rubber with an estimate of the equity cost of capital between 9.20% and 21.08%, using a range of reasonable assumptions.

What is a financial manager to do when one estimate is more than twice as large as another estimate? A financial manager who believes the equity cost of capital is close to 9% is likely to make very different choices from one who believes the cost is closer to 21%. This is why it is important for a financial manager to have a broad understanding of the operations of a particular company. First, the manager must know the historical background from which these numbers were derived. It is not enough for the manager to know that beta is estimated as 1.24 or 2.26; the manager must be able to determine why the estimates are so different. Second, the manager must be familiar enough with the company and the economic environment to draw a conclusion about what set of assumptions will most likely be reasonable going forward. While these numbers are based on historical data, the financial manager's main concern is what the numbers will be going forward.

It is evident that estimating the equity cost of capital is not a simple task for companies. Although we do see a wide range of estimates in the table, some general principles emerge. First, the average company has a beta of 1. With a risk-free rate of 3% and a market risk premium in the range of 5% to 8%, the cost of equity capital will fall within a range of 8% to 11% for the average company. Companies that have a beta less than 1 will have an equity cost of capital that falls below this range, and companies that have a beta greater than 1 will have an equity cost of capital that rises above this range.

Recall that a company's beta is heavily influenced by the type of industry. Grocery stores and providers of food products, for example, tend to have betas less than 1. During recessionary times, people still eat, but during expansionary times, people do not significantly increase their spending on these products. Thus, companies such as Kroger, Coca-Cola, and Kraft Heinz will tend to have low betas and a range of equity cost of capital below 8% to 11%.

The sales of companies in other industries tend to be much more volatile. During expansionary periods, people fly to vacation destinations and purchase new homes. During recessionary periods, families cut back on these discretionary expenditures. Thus, companies such as American Airlines and KB Homes will have higher betas and ranges of equity cost of capital that exceed the 8% to 11% average. The higher equity cost of capital is needed to incentivize investors to invest in these companies with riskier cash flows rather than in lower-risk companies.

The CAPM estimate depends on assumptions made, but issues also exist with the constant dividend growth model. First, the constant dividend growth model can be used only for companies that pay dividends. Second,

the model assumes that the dividends will grow at a constant rate in the future, an assumption that is not always reasonable. It also assumes that the financial manager accurately forecasts the growth rate of dividends; any error in this forecast results in an error in estimating the cost of equity capital.

Given the differences in assumptions made when using the constant dividend growth model and the CAPM to estimate the equity cost of capital, it is not surprising that the numbers from the two models differ. When estimating the cost of equity capital for a particular firm, financial managers must examine the assumptions made for both approaches and decide which set of assumptions is more realistic for that particular company.

### Net Debt

Many practitioners use **net debt** rather than total debt when calculating the weights for WACC. Net debt is the amount of debt that would remain if a company used all of its liquid assets to pay off as much debt as possible. Net debt is calculated as the firm's total debt, both short-term and long-term, minus the firm's cash and cash equivalents. Cash equivalents are current assets that can quickly and easily be converted into cash, such as Treasury bills, commercial paper, and marketable securities.

Consider, for example, Apple, which had $112.436 billion in total debt in 2020. The company also had $38.016 billion in cash and cash equivalents. This meant that the net debt for Apple was only $74.420 billion. If Apple used all of its cash and cash equivalents to pay debt, it would be left with $74.420 billion in debt.[2]

Cash and cash equivalents can be viewed as negative debt. For firms with relatively low levels of cash, this adjustment will not have a large impact on the overall WACC estimate. However, the adjustment can be important for firms that hold substantial cash reserves.

## 17.4 Capital Structure Choices

By the end of this section, you will be able to:

- Distinguish between a levered and an unlevered firm.
- Explain why the choice of capital structure does not impact the value of a firm in perfect financial markets.
- Calculate the interest tax shield.
- Explain how the interest tax shield encourages the use of leverage.

So far, we have taken the company's capital structure as given. Each firm's capital structure, however, is a result of intentional decisions made by the financial managers of the company. We now turn our attention to the issues that financial managers consider when making these decisions.

### The Unlevered Firm

Let's begin our discussion of capital structure choices by exploring the financing decisions you would face if you were to start a T-shirt business. Suppose that your hometown will host an international cycling competition. The competition itself will last for a month; cyclists will arrive early to train in the local climate. News coverage will be significant, meaning a lot of media personnel will be visiting your area. In addition to fans attending the event, it is expected that tourism will increase over the next year as recreational cyclists will want to ride the route of the professional race. You decide to operate a business for one year that will sell T-shirts highlighting this event.

You will need to make an up-front investment of $40,000 to start the business. You estimate that you will generate a cash flow of $52,000, after you cover all of your operating costs, at the end of next year. You know that these profits are risky; you think a 10% risk premium is appropriate for the level of riskiness of the business. If the risk-free rate is 4%, this means that the appropriate discount rate for you to use is 14%. The value of this business opportunity is

2 "Historical Data." Apple Inc. (AAPL). Yahoo! Finance, accessed October 29, 2021. https://finance.yahoo.com/quote/AAPL/history/

$$\text{Value of Business} = \frac{\$52{,}000}{1.14} - \$40{,}000 = \$45{,}614 - \$40{,}000 = \$5614 \quad \textbf{17.13}$$

This looks as if it will be a profitable business that should be undertaken. However, you do not have the $40,000 for the up-front investment and will need to raise it.

First, consider raising money solely by selling ownership shares to your family and friends. How much would those shares be worth? The value of the stock would be equal to the present value of the expected future cash flows. The potential stockholders would expect to receive $45,614 in one year. If they agree with you that the riskiness of this T-shirt business warrants a discount rate of 14%, then they will value the stock at

$$\text{Present Value} = \frac{\$52{,}000}{1.14} = \$45{,}614 \quad \textbf{17.14}$$

If you sell all of the equity in the company for $45,614 and purchase the equipment necessary for the project for $40,000, you have $5,614 to keep as the entrepreneur who created the business.

This business would be financed 100% by equity. The lack of any debt in the capital structure means the firm would have no financial leverage. The equity in a firm that has no financial leverage is called **unlevered equity**.

## The Levered Firm

Next, consider borrowing some of the money that you will need to start this T-shirt business. Although the cash flows from the business are uncertain, suppose you are certain that the business will generate at least $18,000. (Perhaps you have a guaranteed order from the cycling competition sponsors.) If you borrowed $17,000 at the risk-free interest rate of 4%, you would owe $\$17{,}000 \times (1.04) = \$17{,}680$ to the lenders at the end of the year. Because you are certain that you will generate at least $18,000 in cash, which is greater than $17,680, you can borrow the $17,000 without any risk of defaulting.

The $17,000 will not be enough to pay for all the start-up costs. You will also need to raise some capital by selling equity. Because your firm will have some debt, or financial leverage, the equity that you raise will be known as **levered equity**. The equity holders expect the firm to generate $52,000 in cash flows. Debt holders must be paid before equity holders, so this will leave $\$52{,}000 - \$17{,}680 = \$34{,}320$ for the shareholders.

The expected future cash flows generated by the business are determined by the productivity of its assets, not the manner in which those assets are financed. It is the present value of these expected future cash flows that determines the firm's value. Thus, the firm's value in perfect capital markets will not change as a result of the company taking on leverage.

LINK TO LEARNING

### MM Proposition I

Nobel laureates Franco Modigliani and Merton Miller wrote influential papers exploring capital structure and the cost of a firm's capital. They began by considering what would occur in a perfectly competitive market. One of the assumptions of this perfect capital market is that there are no taxes. The idea that the market value of the unlevered and levered firm is the same in perfect capital markets is known in the field of finance as MM Proposition I.

Visit Milken Institute's 5-Minute Finance site to explore more about Modigliani and Miller's contributions (https://openstax.org/r/Modigliani) to the understanding of capital structure.

The value of your T-shirt business remains at $45,614. You can calculate the value of the levered equity as

$$\begin{aligned} \text{Value of Firm} &= D + E \\ \$45{,}614 &= \$17{,}000 + E \\ E &= \$45{,}614 - \$17{,}000 = \$28{,}614 \end{aligned} \quad \textbf{17.15}$$

Now, shareholders are willing to pay $28,614 for ownership in this company. They expect to get $34,320 in one year in return for purchasing this equity. What discount rate does this imply?

$$\begin{aligned} \frac{\$34{,}320}{1 + r_E} &= \$28{,}614 \\ \frac{\$34{,}320}{\$28{,}614} &= 1 + r_E \\ r_E &= 19.94\% \end{aligned} \quad \textbf{17.16}$$

Notice that the expected return to shareholders has risen from 14% for the unlevered firm to 19.94% for the levered firm. Recall that the expected return to shareholders equals the risk-free rate plus a risk premium. The risk-free rate has remained 4%. With leverage, the risk premium rises from 10% to 15.94%.

Why does this risk premium increase? Recall that debt holders are paid before equity holders. Equity holders are residual claimants; they will only receive payment if there is money left over after the debt holders are fully paid. The business is risky. You are certain that the company will have cash flow of at least $18,000 at the end of the year and that $17,680 will be paid to the debt holders. Therefore, if the company performs poorly (perhaps bad weather results in the cancellation of much of the cycling competition) and the cash flows fall way below what you are expecting, there may be only several hundred dollars left for the shareholders.

When the firm was unlevered, if the cash flow at the end of the year was only $18,000, the shareholders would receive $18,000. When leverage is used, the same cash flow would result in shareholders receiving only $320. The risk to the shareholders increases as leverage is used; thus, the risk premium that shareholders require also increases as leverage is used.

## Leverage and the WACC

What happens to the WACC as leverage is used? To figure this out, we must calculate the weights of debt and equity in the capital structure:

$$\begin{aligned} D\% &= \frac{\$17{,}000}{\$45{,}614} = 37.27\% \\ E\% &= \frac{\$28{,}614}{\$45{,}614} = 62.73\% \end{aligned} \quad \textbf{17.17}$$

In perfect capital markets, an assumption we are making for now, there are no taxes. Because we are using only debt and common stock, the weight of preferred stock is zero, and our WACC can be calculated as

$$\begin{aligned} \text{WACC} &= 37.27\% \times 0.04(1 - 0) + 62.73\% \times 0.1994 \\ &= 1.49\% + 12.51\% \\ &= 14\% \end{aligned} \quad \textbf{17.18}$$

Notice that the use of leverage does not change the WACC. When only equity was used to finance the business, stockholders required a 14% expected return to encourage them to let the firm use their capital. When leverage was used, the debt holders only required a 4% return. However, the existence of debt holders, who stand in front of shareholders in the order of claimants, puts shareholders in a riskier position. There is a greater chance that the shareholders will not receive payment from this uncertain business. Thus, the shareholders require a higher rate of return to let the leveraged firm use their capital.

The cost-savings benefits of using lower-cost debt in your company's capital structure are exactly offset by the higher return that shareholders require when leverage is used. Mathematically, the increase in the cost of equity when leverage is used will be proportional to the debt–equity ratio. Financial managers refer to this outcome as MM Proposition II. The relationship is expressed by the formula

$$r_E = r_u + \frac{D}{E}(r_u - r_D) \quad 17.19$$

where $r_u$ is the required return to equity holders of the unlevered firm.

Table 17.4 shows how the cost of equity increases as the weight of debt in the capital structure increases. As the company uses more debt, the risk to equity holders increases. Because equity holders risk that there will be no residual money after bondholders are paid, the equity holders require a higher rate of return to invest in the company as its use of leverage increases. Although debt holders face less risk than equity holders, the risk that they face increases as the amount of debt the company takes on increases. Once the company's debt exceeds its guaranteed cash flow, which is $18,000 in our example, debt holders face some risk that the company will not be able to pay them. At that point, the cost of debt rises above the risk-free rate. As the weight of debt approaches 100%, the cost of debt capital approaches the cost of equity of the unlevered firm. In other words, if you financed the T-shirt business solely through the use of debt, the debt holders would require a 14% return because they would be bearing the entire risk of the business and would demand to be rewarded for doing so.

As the leverage of the firm increases, both the cost of debt capital and the cost of equity capital increase. However, as the firm's leverage increases, it is using proportionately more of the relatively cheaper source of capital—debt— and proportionately less of the relatively more expensive source of capital—equity. Thus, the WACC remains constant as leverage increases, despite the rising cost of each component.

| Amount of Debt | Amount of Equity | Weight of Debt | Weight of Equity | Cost of Debt | Cost of Equity | WACC |
|---|---|---|---|---|---|---|
| $ - | $45,614 | 0% | 100% | 0.0400 | 0.1400 | 14% |
| $5,000 | $40,614 | 11% | 89% | 0.0400 | 0.1523 | 14% |
| $10,000 | $35,614 | 22% | 78% | 0.0400 | 0.1681 | 14% |
| $15,000 | $30,614 | 33% | 67% | 0.0400 | 0.1890 | 14% |
| $17,000 | $28,614 | 37% | 63% | 0.0400 | 0.1994 | 14% |
| $20,000 | $25,614 | 44% | 56% | 0.0600 | 0.2025 | 14% |
| $30,000 | $15,614 | 66% | 34% | 0.0800 | 0.2553 | 14% |
| $40,000 | $5,614 | 88% | 12% | 0.1000 | 0.4250 | 14% |

**Table 17.4 Alternative Capital Structures for Your T-Shirt Business**

## The Impact of Taxes

In perfect capital markets, the choice of capital structure will not impact the value of the firm or the cost of the firm's financing. In the real world, however, capital markets are not perfect. One of the important market imperfections is the presence of corporate taxes. Because the choice of capital structure can impact the taxes that a company pays, in the real world, capital structure can impact the cost of capital and the firm's value.

Assume that your T-shirt business venture will result in earnings before interest and taxes (EBIT) of $52,000 next year and that the corporate tax rate is 28%. If your company is unlevered, it has no interest expense, and its net income will be $37,440, as shown in Table 17.5.

| | Without Leverage | With Leverage |
|---|---|---|
| EBIT | $52,000.00 | $52,000.00 |
| Interest Expense | 0.00 | 280.00 |
| Income before Taxes | 52,000.00 | 51,720.00 |

**Table 17.5 Net Income and Leverage**

| | Without Leverage | With Leverage |
|---|---|---|
| Taxes (28%) | 14,560.00 | 14,481.60 |
| **Net Income** | **$37,440.00** | **$37,238.40** |

**Table 17.5 Net Income and Leverage**

If your company uses leverage, raising $7,000 of financing by issuing debt with a 4% interest rate, it will have an interest expense of $280. This lowers its taxable income to $51,720 and its taxes to $14,481.60. Because interest is a tax-deductible expense, using leverage lowers the company's taxes.

Table 17.6 shows that the company's net income is lower with leverage than it would be without leverage. In other words, debt obligations will reduce the value of the equity. However, less equity is needed because some of the firm is financed through debt. The important consideration is how the use of leverage changes the total amount of dollars available to all investors. Table 17.6 shows this impact.

| | Without Leverage | With Leverage |
|---|---|---|
| Interest Paid to Debt Holders | $0.00 | $280.00 |
| Amount Available to Stockholders | 37,440.00 | 37,238.40 |
| **Total Available for All Investors** | **$37,440.00** | **$37,518.40** |

**Table 17.6 Total Dollars Available to Investors**

Using leverage allows the firm to generate $37,518.40 to pay its investors, compared to only $37,440 that is available if the firm is unlevered. Where does the extra $78.40 to pay investors come from? It comes from the reduction in taxes that the firm pays due to leverage. If the company uses no debt, it pays $14,560 in taxes. The levered firm pays only $14,481.60 in taxes, a savings of $78.40.

The $280 that the levered company pays in interest is shielded from the corporate tax, resulting in tax savings of $0.28 \times \$280 = \$78.40$. The additional amount available to investors because of the tax deductibility of interest payments is known as the **interest tax shield**. The interest tax shield is calculated as

$$\text{Interest Tax Shield} = \text{Corporate Tax Rate} \times \text{Interest Payments} \tag{17.20}$$

When interest is a tax-deductible expense, the total value of the levered firm will exceed the value of the unlevered firm by the amount of this interest tax shield. The tax-advantage status of debt financing impacts the WACC. The WACC with taxes is calculated as

$$\begin{aligned} \text{WACC} &= D\% \times r_{\text{d}}(1-T) + E\% \times r_{\text{e}} \\ &= \frac{D}{E+D} \times r_{\text{d}}(1-T) + \frac{E}{E+D} \times r_{\text{e}} \end{aligned} \tag{17.21}$$

This formula can be written as

$$\begin{aligned} \text{WACC} &= \frac{D}{E+D} \times r_{\text{d}} - \frac{D}{E+D} \times r_{\text{d}} \times T + \frac{E}{E+D} \times r_{\text{e}} \\ &= \frac{D}{E+D} \times r_{\text{d}} + \frac{E}{E+D} \times r_{\text{e}} - \frac{D}{E+D} \times r_{\text{d}} \times T \end{aligned} \tag{17.22}$$

Thus, the WACC with taxes is lower than the pretax WACC because of the interest tax shield. The more debt the firm has, the greater the dollar amount of this interest tax shield. The presence of the interest tax shield encourages firms to use debt financing in their capital structures.

# 17.5 Optimal Capital Structure

By the end of this section, you will be able to:

- Explain how increased use of leverage increases the possibility of financial distress.
- Explain how the possibility of financial distress impacts the cost of capital.
- Discuss the trade-offs a firm faces as it increases its leverage.
- Explain the concept of an optimal capital structure.

## Debt and Financial Distress

The more debt a company uses in its capital structure, the larger the dollar value of the interest tax shield. Why, then, do we not see firms using a capital structure composed 100% of debt to maximize this interest tax shield?

The answer to this question lies in the fact that as a company increases its debt, there is a greater chance that the firm will be unable to make its required interest payments on the debt. If the firm has difficulty meeting its debt obligations, it is said to be in **financial distress**.

A firm in financial distress incurs both direct and indirect costs. The direct costs of financial distress include fees paid to lawyers, consultants, appraisers, and auctioneers. The indirect costs include loss of customers and suppliers.

## Trade-Off Theory

**Trade-off theory** weighs the advantages and disadvantages of using debt in the capital structure. The advantage of using debt is the interest tax shield. The disadvantage of using debt is that it increases the risk of financial distress and the costs associated with financial distress.

A company has an incentive to increase leverage to exploit the interest tax shield. However, too much debt will make it more likely that the company will default and incur financial distress costs. Calculating the precise balance between these two is difficult if not impossible.

For companies with a low level of debt, the risk of default is low, and the main impact of an increase in leverage will be an increase in the interest tax shield. At some point, however, the tax savings that result from increasing the amount of debt in the capital structure will be just offset by the increased probability of incurring the costs of financial distress. For firms that have higher costs of financing distress, this point will be reached sooner. Thus, firms that face higher costs of financial distress have a lower optimal level of leverage than firms that face lower costs of financial distress.

### LINK TO LEARNING

#### Netflix

Netflix has experienced phenomenal growth in the past 25 years. Starting as a DVD rental company, Netflix quickly shifted its model to content streaming. In recent years, the company has become a major producer of content, and it is currently the largest media/entertainment company by market capitalization. It is expensive for Netflix to fund the production of this content. Netflix has funded much of its content through selling debt.

You can view the company's explanation of this capital structure choice by looking at the answers the company provides to common investor questions (https://openstax.org/r/the-company-provides). You can also find the company's financial statements on its website and see how the level of debt on Netflix's balance sheet has increased over the past few years.

Figure 17.4 demonstrates how the value of a levered firm varies with the level of debt financing used. $V_u$ is the value of the unlevered firm, or the firm with no debt. As the firm begins to add debt to its capital structure, the value of the firm increases due to the interest tax shield. The more debt the company takes on, the greater the tax benefit it receives, up until the point at which the company's interest expense exceeds its earnings before interest and taxes (EBIT). Once the interest expense equals EBIT, the firm will have no taxable income. There is no tax benefit from paying more interest after that point.

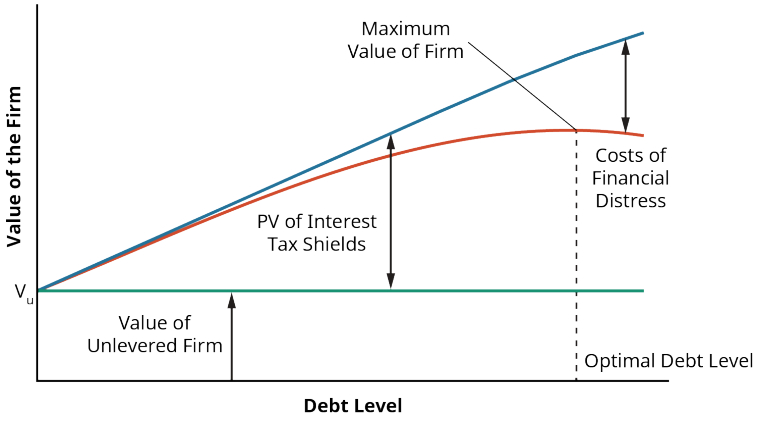



**Figure 17.4 Maximum Value of a Levered Firm**

As the firm increases debt and increases the value of the tax benefit of debt, it also increases the probability of facing financial distress. The magnitude of the costs of financial distress increases as the debt level of the company rises. To some degree, these costs offset the benefit of the interest tax shield.

The optimal debt level occurs at the point at which the value of the firm is maximized. A company will use this optimal debt level to determine what the weight of debt should be in its target capital structure. The optimal capital structure is the target. Recall that the market values of a company's debt and equity are used to determine the costs of capital and the weights in the capital structure. Because market values change daily due to economic conditions, slight variations will occur in the calculations from one day to the next. It is neither practical nor desirable for a firm to recalculate its optimal capital structure each day.

Also, a company will not want to make adjustments for minor differences between its actual capital structure and its optimal capital structure. For example, if a company has determined that its optimal capital structure is 22.5% debt and 77.5% equity but finds that its current capital structure is 23.1% debt and 76.9% equity, it is close to its target. Reducing debt and increasing equity would require transaction costs that might be quite significant.

Table 17.7 shows the average WACC for some common industries. The calculations are based on corporate information at the end of December 2020. A risk-free rate of 3% and a market-risk premium of 5% are assumed in the calculations. You can see that the capital structure used by firms varies widely by industry. Companies in the online retail industry are financed almost entirely through equity capital; on average, less than 7% of the capital comes from debt for those companies. On the other hand, companies in the rubber and tires industry tend to use a heavy amount of debt in their capital structure. With a debt weight of 63.62%, almost two-thirds of the capital for these companies comes from debt.

| Industry Name | Equity Weight | Debt Weight | Beta | Cost of Equity | Tax Rate | After-Tax Cost of Debt | WACC |
|---|---|---|---|---|---|---|---|
| Retail (online) | 93.33% | 6.67% | 1.16 | 8.82% | 2.93% | 2.19% | 8.38% |
| Computers/peripherals | 91.45% | 8.55% | 1.18 | 8.92% | 3.71% | 1.88% | 8.32% |

**Table 17.7 Capital Structure, Cost of Debt, Cost of Equity, and WACC for Selected Industries** (data source: Aswath Damodaran Online)

| Industry Name | Equity Weight | Debt Weight | Beta | Cost of Equity | Tax Rate | After-Tax Cost of Debt | WACC |
|---|---|---|---|---|---|---|---|
| Household products | 87.07% | 12.93% | 0.73 | 6.65% | 5.06% | 2.19% | 6.07% |
| Drugs (pharmaceutical) | 84.62% | 15.38% | 0.91 | 7.54% | 1.88% | 2.19% | 6.72% |
| Retail (general) | 82.41% | 17.59% | 0.90 | 7.49% | 12.48% | 1.88% | 6.51% |
| Beverages (soft) | 82.24% | 17.76% | 0.79 | 6.96% | 3.32% | 2.19% | 6.11% |
| Tobacco | 76.74% | 23.26% | 0.72 | 6.61% | 8.69% | 1.88% | 5.51% |
| Homebuilding | 75.34% | 24.66% | 1.46 | 10.29% | 15.91% | 2.19% | 8.30% |
| Food processing | 75.18% | 24.82% | 0.64 | 6.18% | 8.56% | 2.19% | 5.19% |
| Restaurants/dining | 74.79% | 25.21% | 1.34 | 9.72% | 3.19% | 2.19% | 7.82% |
| Apparel | 71.74% | 28.26% | 1.10 | 8.49% | 4.75% | 2.19% | 6.71% |
| Farming/agriculture | 68.94% | 31.06% | 0.87 | 7.37% | 6.45% | 1.88% | 5.67% |
| Packaging & containers | 64.47% | 35.53% | 0.92 | 7.61% | 15.67% | 1.88% | 5.57% |
| Food wholesalers | 64.10% | 35.90% | 1.03 | 8.17% | 0.52% | 2.19% | 6.02% |
| Hotels/gaming | 63.60% | 36.40% | 1.56 | 10.82% | 2.02% | 2.19% | 7.68% |
| Telecom. services | 54.60% | 45.40% | 0.66 | 6.30% | 3.93% | 1.40% | 4.07% |
| Retail (grocery and food) | 51.46% | 48.54% | 0.24 | 4.21% | 13.52% | 2.19% | 3.23% |
| Air transport | 38.26% | 61.74% | 1.61 | 11.04% | 6.00% | 2.19% | 5.58% |
| Rubber & tires | 36.38% | 63.62% | 1.09 | 8.47% | 5.30% | 1.88% | 4.28% |

**Table 17.7 Capital Structure, Cost of Debt, Cost of Equity, and WACC for Selected Industries** (data source: Aswath Damodaran Online)

Industries that have high betas, such as hotels/gaming and air transport, have high equity costs of capital. More recession-proof industries, such as food processing and household products, have low betas and low equity costs of capital. The WACC for each industry ends up being influenced by the weights of equity and debt the company chooses, the riskiness of the industry, and the tax rates faced by companies in the industry.

## 17.6 Alternative Sources of Funds

By the end of this section, you will be able to:

- Calculate the required return to preferred shareholders.
- Calculate the WACC of a firm that issues preferred shares.
- Discuss how issuing new equity impacts the cost of equity capital.
- Explain the functionality of convertible debt.

A company can finance its assets in two ways: through debt financing and through equity financing. Thus far, we have treated these sources as two broad categories, each with a single cost of capital. In reality, a company may have different types of debt or equity, each with its own cost of capital. The same principle would apply: the WACC of the firm would be calculated using the weights of each of these types multiplied by the cost of that particular type of debt or equity capital.

### Preferred Shares

Although our calculations of WACC thus far have assumed that companies finance their assets only through debt and common equity, we saw at the beginning of the chapter that the basic WACC formula is

$$\text{WACC} = D\% \times r_{\text{d}}(1-T) + P\% \times r_{\text{pfd}} + E\% \times r_{\text{e}} \quad \textbf{17.23}$$

In addition to common stock, a company can raise equity capital by issuing **preferred stock**. Owners of preferred stock are promised a fixed dividend, which must be paid before any dividends can be paid to common stockholders.

In the order of claimants, preferred shareholders stand in line between bondholders and common shareholders. Bondholders are paid interest before preferred shareholders are paid annual dividends. Preferred shareholders are paid annual dividends before common shareholders are paid dividends. Should the company face bankruptcy, the same priority of claimants is followed in settling claims—first bondholders, then preferred stockholders, with common stockholders standing at the end of the line.

Preferred stock shares some characteristics with debt financing. It has a promised cash flow to its holders. Unlike common equity, the dividend on preferred stock is fixed and known. Also, there are consequences if those preferred dividends are not paid. Common shareholders cannot receive any dividends until preferred dividends are paid, and in some cases, preferred shareholders receive voting rights until they are paid the dividends that are due. However, preferred shareholders cannot force the company into bankruptcy as debt holders can. For tax and legal purposes, preferred stock is treated as equity.

The cost of the preferred equity capital is calculated using the formula

$$r_{\text{pfd}} = \frac{Div_{\text{pfd}}}{P_{\text{pfd}}} \tag{17.24}$$

Suppose that Greene Building Company has issued preferred stock that pays a dividend of $2.00 each year. If this preferred stock is selling for $21.80 per share, then the company's cost of preferred stock is

$$r_{\text{pfd}} = \frac{\$2.00}{\$21.80} = 9.17\% \tag{17.25}$$

## THINK IT THROUGH

### Calculating Common Equity Financing

Greene Building Company uses 40% debt, 15% preferred stock, and 45% common stock in its capital structure. The yield to maturity on the company's bonds is 7.2%. The cost of preferred equity is 9.17%. In the most recent year, Greene paid a dividend of $3.15 to its common shareholders. This dividend has been growing at a rate of 3.0% per year, which is expected to continue in the future. The company's common stock is trading for $32.25 per share. Greene pays a corporate tax rate of 21%. Estimate the WACC for Greene.

**Solution:**

The cost of Greene's common equity financing must be calculated. This can be done using the constant dividend growth model:

$$r_{\text{e}} = \frac{Div_1}{P_0} + g = \frac{(\$3.15 \times 1.03)}{\$32.25} + 0.03 = 0.1006 + 0.03 = 13.06 \tag{17.26}$$

The weights and the costs for each component of capital are placed in the WACC formula:

$$\begin{aligned} \text{WACC} &= D\% \times r_{\text{d}}(1-T) + P\% \times r_{\text{pfd}} + E\% \times r_{\text{e}} \\ &= 40\% \times 0.0702(1-0.21) + 15\% \times 0.0917 + 45\% \times 0.1306 \\ &= 2.218\% + 1.3755\% + 5.8770\% = 9.4705\% \end{aligned} \tag{17.27}$$

The WACC for Greene Building Company is estimated to be 9.47%. Note that debt financing is the cheapest cost of capital for Greene. The reason for this is twofold. First, because debt holders face the least amount of risk because they are paid first in the order of claimants, they require a lower return. Second, because

interest payments are tax-deductible, the interest tax shield lowers the effective cost of debt to the company. Preferred shareholders will require a higher rate of return than debt holders, 9.17%, because they are later in the order of claimants. Common shareholders are the residual claimants, standing at the end of the line to receive payment. After all other claimants are paid, any remaining money belongs to the shareholders. If this residual amount is small, the common shareholders receive a small payment. If there is nothing left after all other claimants have been paid, common shareholders receive nothing. Thus, common shareholders have the greatest amount of risk and require the highest rate of return.

Also, note that the weights for debt, preferred stock, and common stock in the capital structure sum to 100%. The company must finance 100% of its assets.

## Issuing New Common Stock

An existing firm can acquire equity capital to expand its assets in two ways: the retention of earnings or the sale of new shares of stock. Thus far in the chapter, the cost of equity capital calculations have assumed that the earnings were being retained for equity capital financing.

The net income that is left after all expenses are paid is the residual income that belongs to the shareholders. Instead of receiving a fixed payment for letting the firm use their capital (like bondholders who receive fixed interest payments), the reward to shareholders for letting the company use their capital varies from year to year. In a good year, net income and the reward to shareholders is high. In a poor year, net income is low or perhaps even negative.

The net income can either be paid immediately and directly to shareholders in the form of dividends or be retained within the company to fund growth. Shareholders are willing to allow the company to retain these earnings because they expect that the money will be used to fund profitable projects, leading to an even larger reward for shareholders in future years.

Although managers do not need to actively solicit the funds that are retained to fund the business, managers cannot view these funds as costless. The shareholders will require a return on those funds to entice them to allow the company to delay paying the dollars to them immediately in terms of a dividend.

Suppose a company has $1 million in net income one year. If it pays $250,000 in dividends and retains $750,000, then it can finance $750,000 more in assets. If the company has a capital structure of 25% debt and 75% equity and wants to maintain that capital structure, it must increase its debt by $250,000 to balance the increase in equity. Thus, the company would be increasing its total financing by $1 million. Of that financing, 25% would be debt financing, and 75% would be equity financing.

To increase its assets by more than $1 million, the company would need to decide to either change its capital structure or issue new stock. Consider the firm represented by the market-value balance sheet in Figure 17.5. The firm has $900 million in assets. These assets are financed by $225 million in debt capital and $675 million in equity capital, resulting in a capital structure of 25% debt and 75% equity.

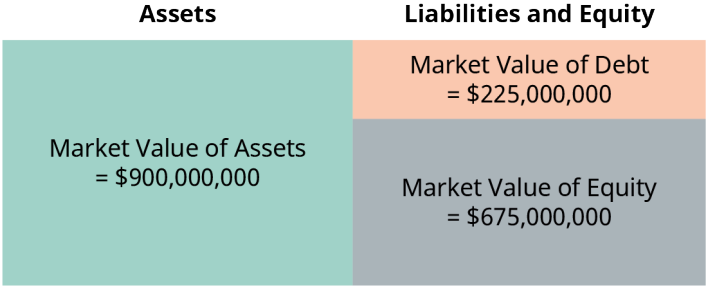



**Figure 17.5 Market-Value Balance Sheet for a Company with $900 Million in Assets and a Capital Structure of 25% Debt and 75% Equity**

The retained earnings of $750,000 cause the equity on the balance sheet to increase to $675.75 million. The company could sell $250,000 in bonds, increasing its debt to $225.25 million. Figure 17.6 shows the impact on the balance sheet. The company has increased its financing by $1,000,000 and can expand assets by $1,000,000. The capital structure remains 25% debt and 75% equity.

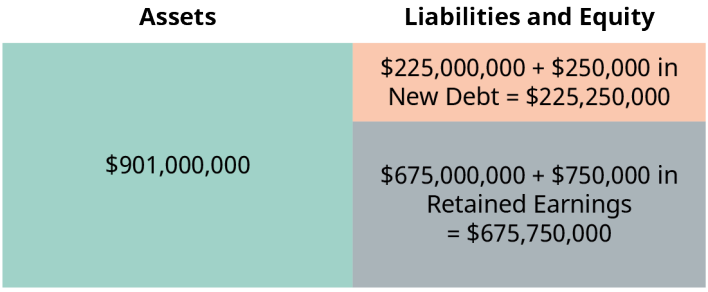



**Figure 17.6 Balance Sheet with $1 Million Growth Financed through Retained Earnings and New Debt**

What if the economy is in an expansionary period and this company thinks it has the opportunity to grow at a rate of 5%? The company knows that it will need more assets to be able to grow. If it needs 5% more assets, its assets will need to increase to $945 million. To increase the left-hand side of its balance sheet, the company will also need to increase the right-hand side of the balance sheet.

Where does the company get the $45 million in capital? With $750,000 in retained earnings, the company can increase its equity to $675.75 million, but if the remainder of $44.25 million was financed through debt, the company's capital structure would change. Its weight of debt would increase to

$$\frac{\$225{,}000{,}000 + \$44{,}250{,}000}{\$945{,}000{,}000} = 0.2849 = 28.49\%.$$

If the company has determined that its optimal capital structure is 25% debt and 75% equity, financing the majority of the growth through debt would cause it to stray from these levels. Funding the growth while keeping the capital structure the same would require the firm to issue new shares. Figure 17.7 shows how the firm would need to finance $45 million in growth while maintaining its desirable capital structure. The firm would need to increase equity capital to $708.75 million; retained earnings could provide $750,000, but $33 million of new equity would need to be sold.

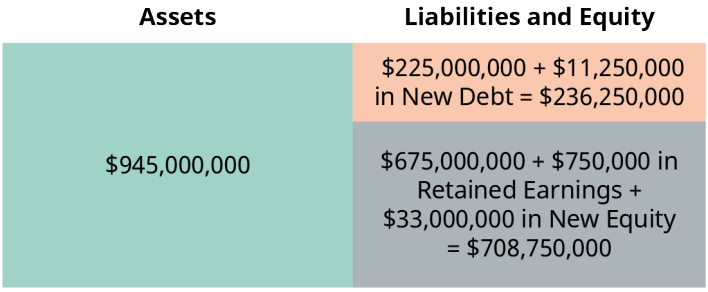



**Figure 17.7 Balance Sheet with $45,000,000 in Financing Coming from Debt, Retained Earnings, and New Stock**

Investors who are providing common equity financing require a return to entice them to let the company use their money. If this company has paid $0.50 per share in dividends to shareholders and this dividend is expected to increase by 3% each year, we can use the constant dividend growth model to estimate how much common shareholders require. If the stock is trading for $8.00 per share, the cost of common equity financing is estimated as

$$r_e = \frac{Div_1}{P_0} + g = \frac{\$0.515}{\$8} + 0.03 = 0.0644 + 0.03 = 0.0944 = 9.44\% \quad \textbf{17.28}$$

If, however, the firm must issue more equity, its cost of equity for those additional shares will be higher than 9.44%. Even if shareholders are willing to pay $8.00 per share for the stock, the firm will incur **flotation costs**; this means the firm will not receive the entire $8.00 to use to finance new assets and generate a profit for

shareholders. Flotation costs include the costs of filing with the Securities and Exchange Commission (SEC) as well as the fees paid to investment bankers to place the new shares.

When new equity must be issued to finance the company, the flotation costs must be subtracted from the price of the stock to determine the net proceeds the firm will receive. The cost of this new equity capital is calculated as

$$r_{e-\text{new}} = \frac{Div_1}{P_0 - F} + g \quad \textbf{17.29}$$

where $F$ represents the flotation costs of the new stock issue. If, in this example, the flotation cost is \$0.25 per share, then the cost of raising new equity capital is

$$r_{e-\text{new}} = \frac{Div_1}{P_0 - F} + g = \frac{0.515}{\$8 - 0.25} + 0.03 = 0.0665 + 0.03 = 0.09 = 9.65\% \quad \textbf{17.30}$$

Issuing new common equity is the most expensive form of raising capital. Equity capital is already expensive because the common shareholders are the residual claimants who will only be paid if all other claimants are paid. Because of this risk, they require a higher rate of return than providers of capital who have precedence in the order of claimants. Flotation costs must be added to this equity cost when new shares are issued to grow the company.

## THINK IT THROUGH

### Cost of Issuing New Equity

You are a financial manager for American Motor Works (AMW). The target capital structure for the company is 30% debt and 70% equity. You know that your company's after-tax cost of debt is 4.6%. Your company paid a dividend of \$3 per share last year, and it has a policy of increasing its dividend at a rate of 1.5% each year. AMW stock is currently trading for \$27.50 per share. You estimate that the company's retained earnings will be \$10 million this year. If the company needs to issue new shares of stock, flotation costs are expected to be \$0.75 per share.

Given this information, you are tasked with calculating the company's WACC. You need to provide an estimate of WACC if retained earnings are used and an estimate if new equity must be issued.

**Solution:**

First, calculate the cost of equity capital for AMW using the constant dividend growth model:

$$r_e = \frac{Div_1}{P_0} + g = \frac{\$3.00(1.015)}{\$27.50} + 0.015 = 0.1107 + 0.015 = 0.1257 = 12.57\% \quad \textbf{17.31}$$

Using 12.57% as the equity cost of capital and 4.6% as the after-tax cost of debt, the WACC is calculated as

$$\begin{aligned} \text{WACC} &= D\% \times r_d(1-T) + E\% \times r_e = 0.30(0.0460) + 0.70(0.1257) \\ &= 0.0138 + 0.0880 = 0.1018 = 10.18\% \end{aligned} \quad \textbf{17.32}$$

The WACC for AMW when it is using retained earnings for equity financing is 10.18%. If the company has \$10 million in retained earnings this year, its equity will increase by \$10 million. Given its target capital structure of 30% debt and 70% equity, AMW will be able to increase its overall financing by $\frac{\$10{,}000{,}000}{0.70} = \$14{,}285{,}714$ by using its retained earnings and issuing new debt of \$4,285,714.

If AMW wants to expand its assets by more than \$14,285,714 during the next year, it will need to issue new stock or increase the weight of debt in its capital structure. The company will incur flotation costs of \$0.65 per share to issue new stock. The cost of new equity capital will be

$$r_e = \frac{Div_1}{P_0} + g = \frac{\$3.00(1.015)}{\$27.50 - \$0.75} + 0.015 = 0.1138 + 0.015 = 0.1288 = 12.88\% \quad \textbf{17.33}$$

With this more expensive newly issued equity capital, AMW's WACC will become

$$\begin{aligned} \text{WACC} &= D\% \times r_d(1-T) + E\% \times r_e = 0.30(0.0460) + 0.70(0.1288) \\ &= 0.0138 + 0.0902 = 0.1040 = 10.40\% \end{aligned} \quad \textbf{17.34}$$

If AMW wants to take on a large project that requires investment in more than $14,285,714 worth of assets, such as building a new production facility, the company will need to issue more equity and will face a higher WACC than when using retained earnings as its equity financing.

## Convertible Debt

Some companies issue **convertible bonds**. These corporate bonds have a provision that gives the bondholder the option of converting each bond held into a fixed number of shares of common stock. The number of common shares the bondholder would receive for each bond is known as the **conversion ratio**.

Suppose that you own a convertible bond issued by Sheridan Sodas with a face value of $1,000 and a conversion ratio of 20 shares that matures today. If you convert the bond today, you will receive 20 shares of Sheridan common stock. If you do not convert, you will receive $1,000. If you convert, you are basically paying $1,000 for 20 shares of Sheridan stock. The **conversion price** is $\frac{\$1{,}000}{20} = \$50$. If Sheridan is trading for more than $50 per share, you would want to convert. If Sheridan is trading for less than $50 per share, you would not want to convert; you would prefer the $1,000. In other words, you will choose to convert whenever the stock price exceeds the conversion price at maturity.

A convertible bond gives the holder an option; the bondholder is able to choose between the face value cash or receiving shares of stock. Options always have a positive value to holders. It is always preferable to be able to choose $1,000 or shares of stock than to simply be given $1,000. There is a possibility that the shares of stock will be more valuable, and there is no way the choice can put you in a worse position.

Because holders of convertible bonds have the valuable option of conversion that holders of nonconvertible bonds do not have, convertible debt can be offered with a lower interest rate. It might seem as if the firm could lower its weighted average cost of capital by issuing convertible debt rather than nonconvertible debt. However, this is not the case. Remember that holders of convertible bonds choose whether they would prefer to convert the bond and become a stockholder or receive the face value of the bond at maturity.

If a bond has a face value of $1,000, the convertible bond holders will consider whether the stock they can convert to is worth more than $1,000. Only when the price of the stock has increased enough that the value of the stock received is more than $1,000 will the bondholders convert. However, this means that instead of paying $1,000, the firm is paying the bondholder in stock worth more than $1,000. In essence, the firm (and the current shareholders) would be selling an equity position in the company for less than the market price of that equity position. The lower interest rate compensates for the possibility that conversion will occur.

# Summary

## 17.1 The Concept of Capital Structure

Capital structure refers to how a company finances its assets. The two main sources of capital are debt financing and equity financing. A cost of capital exists because investors want a return equivalent to what they would receive on an investment with an equivalent risk to persuade them to let the company use their funds. The market values of debt and equity are used to calculate the weights of the components of the capital structure.

## 17.2 The Costs of Debt and Equity Capital

The yield to maturity (YTM) on a company's outstanding bonds represents the return that debt holders are requiring to lend money to the company. Because interest expenses are tax-deductible, the cost of debt to the company is less than the YTM. The cost of equity capital is not directly observed, so financial managers must estimate this cost. Two common methods for estimating the cost of equity capital are the constant dividend growth model and the capital asset pricing model (CAPM).

## 17.3 Calculating the Weighted Average Cost of Capital

Calculate the weighted average cost of capital (WACC) using the formula

$$\text{WACC} = D\% \times r_{\text{d}}(1-T) + P\% \times r_{\text{pfd}} + E\% \times r_{\text{e}} \tag{17.35}$$

Remember that the WACC is an estimate; different methods of estimating the cost of equity capital can lead to different estimations of WACC.

## 17.4 Capital Structure Choices

An unlevered firm uses no debt in its capital structure. A levered firm uses both debt and equity in its capital structure. In perfect financial markets, the value of the firm will be the same regardless of the firm's decision to use leverage. With the tax deductibility of interest expenses, however, the value of the firm can increase through the use of debt. As the level of debt increases, the value of the interest tax shield increases.

## 17.5 Optimal Capital Structure

A company wants to choose a capital structure that maximizes its value. Although increasing the level of financial leverage, or debt, in the capital structure increases the value of the interest tax shield, it also increases the probability of financial distress. As the weight of debt in the capital structure increases, the return that providers of both debt and equity capital require to entice them to provide money to the firm increases because their risk increases. Trade-off theory suggests that the value of a company that uses debt equals the value of the unlevered firm plus the value of the interest tax shield minus financial distress costs.

## 17.6 Alternative Sources of Funds

Preferred stock is a type of equity capital; the owners of preferred stock receive preferential treatment over common stockholders in the order of claimants. A fixed dividend is paid to preferred shareholders and must be paid before common shareholders receive dividends. Equity capital can be raised through either retaining earnings or selling new shares of stock. Significant flotation costs are associated with issuing new shares of stock, making it the most expensive source of financing. Convertible debt allows the debt holders to convert their debt into a fixed number of common shares instead of receiving the face value of the stock at maturity.

# Key Terms

**after-tax cost of debt** the net cost of interest on a company's debt after taxes; the firm's effective cost of debt

**capital** a company's sources of financing

**capital structure** the percentages of a company's assets that are financed by debt capital, preferred stock capital, and common stock capital
**conversion price** the face value of a convertible bond divided by its conversion ratio
**conversion ratio** the number of shares of common stock receivable for each convertible bond that is converted
**convertible bonds** bonds that can be converted into a fixed number of shares of common stock upon maturity
**financial distress** when a firm has trouble meeting debt obligations
**financial leverage** the debt used in a company's capital structure
**flotation costs** costs involved in the issuing and placing of new securities
**interest tax shield** the reduction in taxes paid because interest payments on debt are a tax-deductible expense; calculated as the corporate tax rate multiplied by interest payments
**levered equity** equity in a firm that has debt outstanding
**net debt** a company's total debt minus any cash or risk-free assets the company holds
**preferred stock** equity capital that has a fixed dividend; preferred shareholders fall in between debt holders and common stockholders in the order of claimants
**trade-off theory** a theory stating that the total value of a levered company is the value of the firm without leverage plus the value of the interest tax shield less financial distress costs
**unlevered equity** equity in a firm that has no debt outstanding
**weighted average cost of capital (WACC)** the average of a firm's debt and equity costs of capital, weighted by the fractions of the firm's value that correspond to debt and equity

## CFA Institute

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## Multiple Choice

1. Sandage Auto Parts has debt outstanding with a market value of $2 million. The company's common stock has a book value of $3 million and a market value of $8 million. What weight is equity in Sandage's capital structure?
   **a.** 11%
   **b.** 20%
   **c.** 60%
   **d.** 80%

2. The capital structure of a company refers to _____.
   **a.** whether the company purchases assets or liabilities with its equity
   **b.** the proportion of debt and equity the company uses in financing is assets
   **c.** the ability of the company to use its assets to generate equity for the owners
   **d.** whether the company uses short-term assets or long-term assets to create its product

3. Which of the following should be used when calculating the weights for a company's capital structure?
   **a.** Book values
   **b.** Current market values
   **c.** Historic accounting values
   **d.** Par and face values

4. Two methods for estimating a company's cost of common stock capital are _____.
   **a.** the historic method and the current method
   **b.** the weighted valuation model and the beta model
   **c.** the constant dividend growth model and the CAPM

**d.** the balance sheet method and the face value method

**5**. Which of the following would be the most reasonable approach to calculating the cost of debt for a company?
**a.** Using the coupon rate on the company's existing bonds
**b.** Using the interest amount reported on the income statement
**c.** Using the yield to maturity on the company's existing bonds
**d.** Multiplying the amount of debt on the company's balance sheet by the risk-free rate

**6**. Net debt equals _____.
**a.** Debt/Equity
**b.** Debt × (1 – Tax Rate)
**c.** total debt minus the cash and risk-free assets the company owns
**d.** the yield to maturity of a company's bonds divided by the tax rate

**7**. *Unlevered equity* refers to _____.
**a.** the equity in a firm with no debt
**b.** a firm's equity minus the firm's debt
**c.** the equity in a firm in the absence of taxation and transaction costs
**d.** the portion of a firm's capital structure that is financed by its owners

**8**. In perfect capital markets, _____.
**a.** a company's WACC does not change as it changes its capital structure
**b.** a company can lower its WACC by using more debt in its capital structure
**c.** a company can lower its WACC by using more equity in its capital structure
**d.** a company's cost of debt capital is exactly equal to its cost of equity capital when the company uses 50% debt and 50% equity in its capital structure

**9**. The interest tax shield occurs because _____.
**a.** interest payments are a tax-deductible expense
**b.** interest payments are made from after-tax income
**c.** investors require a lower rate of return the higher the company's tax rate
**d.** investors require a lower rate of return the more debt the company incurs

**10**. As a company increases the weight of debt in its capital structure, _____.
**a.** its cost of debt capital falls
**b.** the weight of equity capital also increases
**c.** the value of the interest tax shield decreases
**d.** its possibility of financial distress increases

**11**. A company is said to be in financial distress if _____.
**a.** it is not fully exploiting the interest tax shield
**b.** it needs to raise capital to finance a new project
**c.** it has difficulty meeting its debt obligations
**d.** its cost of equity capital exceeds its cost of debt capital

**12**. Issuing new stock _____.
**a.** costs the same as retaining earnings
**b.** will not impact a company's WACC
**c.** is the most expensive source of capital because of flotation costs
**d.** is the cheapest source of capital because dividends do not have to be paid each year

**13**. If a bond with a face value of $1,000 has a conversion ratio of 10 shares, the conversion price is _____.
**a.** $0.01

**b.** $10
**c.** $100
**d.** $1,000

## Review Questions

1. Why does a company's capital have a cost?
2. Why is the rate that debt holders require to entice them to lend money to a company different from the company's effective cost of debt capital?
3. Assume that the corporate tax rate is 21%. Congress is discussing increasing the corporate tax rate to 32%. How might this change the capital structures that companies choose?
4. Describe the order of claimants and how it impacts the returns that various providers of capital require to entice them to provide funding to a company.
5. Explain what is meant by *trade-off theory.*

## Problems

1. SodaFizz has debt outstanding that has a market value of $3 million. The company's stock has a book value of $2 million and a market value of $6 million. What are the weights in SodaFizz's capital structure?
2. The yield to maturity on SodaFizz's debt is 7.2%. If the company's marginal tax rate is 21%, what is SodaFizz's effective cost of debt?
3. SodaFizz paid a dividend of $2 per share last year; its dividend has been growing at a rate of 2% per year, and that growth rate is expected to continue into the future. The stock of SodaFizz is currently trading at $19.50 per share. According to the constant dividend growth model, what is the cost of equity capital for SodaFizz?
4. SodaFizz has a beta of 1.1. If the risk-free rate is 3% and the market risk premium is 11%, what is the cost of equity capital for SodaFizz according to the capital asset pricing model?
5. Given the answers to Problems 1, 2, and 3, what is SodaFizz's WACC when the constant dividend growth model is used to calculate its equity cost of capital?
6. Given the answers to Problems 1, 2, and 4, what is SodaFizz's WACC when the CAPM is used to calculate SodaFizz's equity cost of capital?
7. Shirley Manufacturing paid $1 million in interest payments last year. The company is in the 21% tax bracket and has $15 million in debt outstanding. How much was the company's interest tax shield last year?
8. King Medical Supplies has issued preferred stock that pays a yearly dividend of $4 per share. This preferred stock is trading at a price of $47 per share. What is King's cost of preferred stock capital?
9. McPherson Pharmaceutical has common stock that is trading for $75 per share. The company paid a dividend of $5.25 last year. This dividend is expected to increase at a rate of 3% per year. What is the cost of equity capital for McPherson? If McPherson issues new shares with a flotation cost of $2 per share, what is the company's cost of new equity?

## Video Activity

### Calculating the Weighted Average Cost of Capital

Access multimedia content (http://openstax.org/books/principles-finance/pages/17-video-activity)

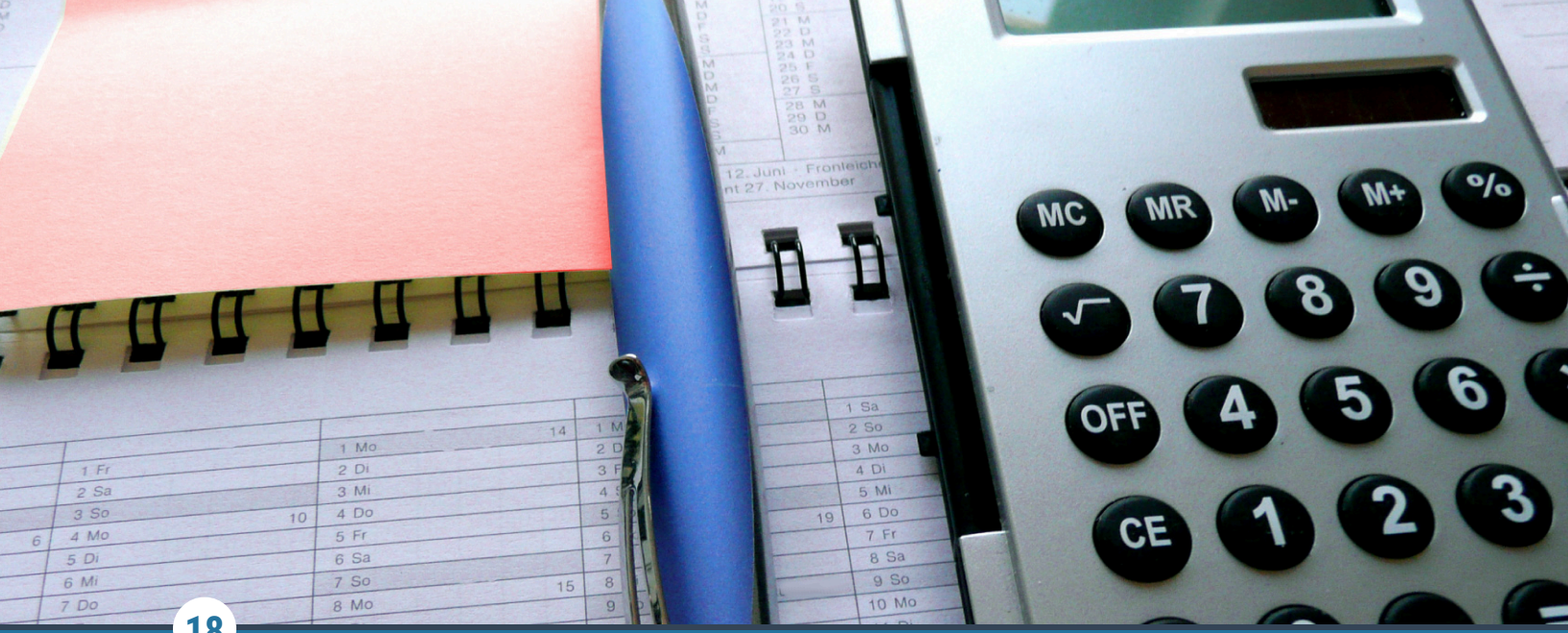
1. What is the formula for calculating WACC? What do each of the components of this formula represent?

2. In the video, the tax rate for Brick and Mortar Co. was 30%. What would your calculation of the company's WACC be if there was a change in the tax code and the tax rate for Brick and Mortar Co. fell to 15%? Why does the tax rate impact a firm's WACC? Do you think the managers of Brick and Mortar Co. should consider making any changes to its capital structure if the tax rate falls to 15%? Why or why not?

## Capital Structure for Real Estate Companies

Click to view video content (https://openstax.org/r/optimal-capital)

3. Why doesn't one optimal capital structure exist for commercial real estate businesses?
4. How do you think a family that runs a multigenerational commercial real estate business will think about risk compared to a young entrepreneur who is beginning to build a commercial real estate business? How do you think the capital structures of these two entities are likely to compare? How would those capital structures likely be linked to the risk profiles of the two companies?




# 18 Financial Forecasting

**Figure 18.1** Forecasts are an important financial tool. (credit: modification of "Red Post-It Label, Calculator and Ballpen" by photosteve101/flickr, CC BY 2.0)

## Chapter Outline

**18.1** The Importance of Forecasting
**18.2** Forecasting Sales
**18.3** Pro Forma Financials
**18.4** Generating the Complete Forecast
**18.5** Forecasting Cash Flow and Assessing the Value of Growth
**18.6** Using Excel to Create the Long-Term Forecast

## Why It Matters

Though no one in business has a crystal ball, managers must often do all they can to predict the future as accurately as possible. This is called *forecasting*. Accounting and finance professionals use past performance along with what they know about the business, its competitors, the economy, and the company's plans for the future to assemble detailed financial forecasts. Forecasts are useful to many individuals for different reasons. A budget, a type of static **forecast**, helps accountants and managers see how their plans for the coming year can be achieved. It outlines sales targets and how much can be spent on cost of goods sold and expenses to achieve the company's bottom-line (net income) targets. Investors use financial forecasts to help guide their decisions to buy, sell or hold stocks or to estimate future potential income through dividends. Perhaps most importantly, for our purposes in finance, forecasts are used to help predict and manage cash flows.

A business can have all the profit in the world at the end of the year, but if it doesn't raise enough cash (liquidity) to pay the bills and pay its employees halfway through the year, it could still go bankrupt despite being profitable. Forecasting sales and expenses helps assemble a cash forecast—when sales will be collected and when expenses will be paid—so that financial managers can look forward far enough to have enough time to react accordingly and secure short- or long-term financing to meet gaps in cash flow.

# 18.1 The Importance of Forecasting

## Learning Outcomes

By the end of this section, you will be able to:

- Discuss how to use financial statements in forecasting firm financials.
- Explain why balance sheet items are important in forecasting a firm's financial result.
- Explain why income statement items are important in forecasting a firm's financial result.

In this section, we will briefly review some of the basic elements of financial statements and how we can analyze historical statements to help assemble financial forecasts. Financial forecasting is important to short- and long-term firm success. It helps a firm plan for the resources it will need, ensuring it will have enough cash on hand at the right time to cover daily operations and capital expenditures. It helps the firm communicate its future potential and manage its shareholders' expectations. It also helps management assess future risk and set plans in place to mitigate that risk.

Financial forecasting involves using historical data, analysis tools, and other information we can gather to make an educated guess about the future financial performance of the firm. Historical figures provide a reasonable starting point. We use tools such as ratios, common size, and trend analysis to fine-tune our forecast. And finally, we assess what we know about the firm, its competitors, the economy, and anything else that might impact performance and further fine-tune our forecast from there.

It's important to take a moment to consider the role of ethics in forecasting. Ethics is a huge issue in the world of accounting and finance in general, and forecasting is no different. There can be tremendous pressure on management to perform, to deliver certain levels of profit, and to meet shareholder expectations.

Forecasting, as you will learn throughout this chapter, is not an exact science. There is a great deal of subjectivity that can come into play when forecasting sales and expenses. Ethical behavior is crucial in this area. Those who create forecasts must have a firm understanding of where their data comes from, how reliable it is, and whether or not their assumptions and projections are reasonably justified.

## Financial Statement Foundations

In Financial Statements, you were introduced to a firm called Clear Lake Sporting Goods. You learned about the four key financial statements: the **income statement**, **balance sheet**, **statement of stockholders' equity**, and **statement of cash flows**. Each one provides a different view of the firm's financial health and performance.

Clear Lake Sporting Goods is a small merchandising company (a company that buys finished goods and sells them to consumers) that sells hunting and fishing gear. It uses financial statements to understand its profitability and current financial position, to manage cash flow, and to communicate its finances to outside parties such as investors, governing bodies, and lenders. We will use Clear Lake's company information and historical financial statements in this chapter as we explore its forecasting process. It's important to note that in this chapter, we are focusing on just one firm and the one method its managers have chosen to forecast financial performance. There are a variety of types of firms in actual application, and they may choose to forecast their financial performance differently. We are demonstrating just one approach here.

The balance sheet shows all the firm's assets, liabilities, and equity at one point in time. It also supports the accounting equation in a very clear and transparent way. We find one section of the balance sheet contains all current and noncurrent assets that must total the other section of the balance sheet: total liabilities and equity. In Figure 18.2, we see that Clear Lake Sporting Goods has total assets of $250,000 in the current year, which balances with its total liabilities and equity of $250,000.

| Clear Lake Sporting Goods<br>Comparative Year-End Balance Sheets | | |
|---|---|---|
| | **Prior Year** | **Current Year** |
| **Assets** | | |
| **Current Assets:** | | |
| Cash | $ 90,000 | $110,000 |
| Accounts Receivable | 20,000 | 30,000 |
| Inventory | 35,000 | 40,000 |
| Short-Term Investments | 15,000 | 20,000 |
| **Total Current Assets** | 160,000 | 200,000 |
| **Noncurrent Assets:** | | |
| Equipment | 40,000 | 50,000 |
| **Total Assets** | $200,000 | $250,000 |
| **Liabilities** | | |
| **Current Liabilities:** | | |
| Accounts Payable | 60,000 | 75,000 |
| Unearned Revenue | 10,000 | 25,000 |
| **Total Current Liabilities** | 70,000 | 100,000 |
| **Noncurrent Liabilities:** | | |
| Notes Payable | 40,000 | 50,000 |
| **Total Liabilities** | $110,000 | $150,000 |
| **Stockholder Equity** | | |
| Common Stock | 75,000 | 80,000 |
| Ending Retained Earnings | 15,000 | 20,000 |
| **Total Stockholder Equity** | 90,000 | 100,000 |
| **Total Liabilities and Stockholder Equity** | $200,000 | $250,000 |

**Figure 18.2 Balance Sheet**

The income statement reflects the performance of the firm over a period of time. It includes net sales, cost of goods sold, operating expenses, and net income. In Figure 18.3, we see that Clear Lake had $120,000 in net sales, $60,000 in cost of goods sold, and $35,000 in net income in the current year.

| Clear Lake Sporting Goods<br>Comparative Year-End Income Statements | | |
|---|---|---|
| | **Prior Year** | **Current Year** |
| Gross Sales | $105,000 | $126,000 |
| Sales Returns & Allowances | 5,000 | 6,000 |
| Net Sales | 100,000 | 120,000 |
| Cost of Goods Sold | 50,000 | 60,000 |
| Gross Profit | 50,000 | 60,000 |
| Rent Expense | 5,000 | 5,500 |
| Depreciation Expense | 2,500 | 3,600 |
| Salaries Expense | 3,000 | 5,400 |
| Utility Expense | 1,500 | 2,500 |
| Operating Income | 38,000 | 43,000 |
| Interest Expense | 3,000 | 2,000 |
| Income Tax Expense | 5,000 | 6,000 |
| Net Income | $ 30,000 | $ 35,000 |

**Figure 18.3 Full Income Statement**

Finally, the statement of cash flows is used to reconcile net income to cash balances. The statement begins with net income, then reflects adjustments to balance sheet accounts and noncash expenses. The statement of cash flows is broken down into three key categories: operating, investing, and financing. This allows users to

clearly see what elements of the business are generating or using cash. In Figure 18.4, we see that Clear Lake had cash flow from **operating activities** of $53,600, cash used for **investing activities** of ($18,600), and cash used for **financing activities** of ($15,000).

**Clear Lake Sporting Goods**
**Statement of Cash Flows**
**Indirect Method**

| | | |
|---|---|---|
| Cash Flow from Operating Activities | | |
| Net Income | | $ 35,000 |
| Adjustment to Reconcile Net Income to Net Cash Flow from Operating Activities: | | |
| Depreciation | $3,600 | |
| Accounts Receivable Increase | (10,000) | |
| Inventory Increase | (5,000) | |
| Accounts Payable Increase | 15,000 | |
| Unearned Revenue Increase | 15,000 | 18,600 |
| Net Cash Flow from Operating Activities | | 53,600 |
| Cash Flow from Investing Activities | | |
| Purchase of Short-Term Investments | (5,000) | |
| Cost of New Plant Assets | (13,600) | |
| Net Cash Flow: Investing Activities | | (18,600) |
| Cash Flow from Financing Activities | | |
| Additional Notes Payable | 10,000 | |
| Issuance of Common Stock | 5,000 | |
| Payment of Dividends | (30,000) | |
| Net Cash Flow from Financing Activities | | (15,000) |
| Total Cash Flow Increase/Decrease | | 20,000 |
| Beginning Cash Balance | | 90,000 |
| Ending Cash Balance | | $110,000 |

**Figure 18.4 Statement of Cash Flows**

Another key concept to remember about the financial statements is that the statement of cash flows is necessary to truly understand how the firm is using and generating cash. A common misconception is that if a firm reports net income on its income statement, then it must have plenty of cash, and if it reports a loss, it must be short on cash. Although this can be true, it's not necessarily the case. Historically speaking, we need the statement of cash flows to get the full picture of how cash was used or generated in the past. Looking to the future, we need a cash flow forecast to plan for possible gaps in cash flow and, potentially, how to make the best use of any cash surplus. Throughout this chapter, we will see how to use historical financial statements to help develop the future cash forecast.

It's also important to remember that the four financial statements are tied together. Net income from the income statement feeds into retained earnings, which live on the balance sheet. Equity balances on the balance sheet feed information to the statement of stockholders' equity. And information from both the income statement (net income and noncash expenses) and the balance sheet (changes in working capital accounts) all feed into the statement of cash flows. These relationships will be helpful to understand when using historical statements and preparing forecasts.

## Balance Sheet Analysis

Fully understanding the items that are on the balance sheet and how they relate to one another and to other financial statements will help you create a financial forecast. In Financial Statements, you learned that on the classified balance sheet, both assets and liabilities are broken down into current and noncurrent categories. You also know that the balance sheet must live up to its name—it must balance. This means that total assets (what the company owns) must equal total liabilities and equity (what the company owes).

You continued your financial statement development in Measures of Financial Health, where you saw how to use elements of the balance sheet to assess financial health. Ratios based on balance sheet accounts can be useful for understanding relationships between balance sheet items—how they related in the past and then, in forecasting, how those relationships might change or remain the same in the future. Examples of balance sheet ratios include the current ratio, quick ratio, cash ratio, debt-to-assets ratio, and debt-to-equity ratio.

In Financial Statements, you also explored common-size analysis. To prepare a **common-size** analysis of the balance sheet, every item on the statement must be expressed as a percentage of total assets. Seeing each item as a percentage—that is, seeing its relationship to total assets—is also helpful for assessing historical statements and how those percentages or relationships can be used to predict future balances in the forecast. For example, in Figure 18.5, you can see that Clear Lake's current assets represented 80% of its total assets in both the current and prior years.

**Clear Lake Sporting Goods**
**Comparative Year-End Balance Sheets**

| | Prior Year | Prior Year % | Current Year | Current Year % |
|---|---|---|---|---|
| **Assets** | | | | |
| **Current Assets:** | | | | |
| Cash | $ 90,000 | 45% | $110,000 | 44% |
| Accounts Receivable | 20,000 | 10% | 30,000 | 12% |
| Inventory | 35,000 | 18% | 40,000 | 16% |
| Short-Term Investments | 15,000 | 8% | 20,000 | 8% |
| **Total Current Assets** | 160,000 | 80% | 200,000 | 80% |
| **Noncurrent Assets:** | | | | |
| Equipment | 40,000 | 20% | 50,000 | 20% |
| **Total Assets** | $200,000 | 100% | $250,000 | 100% |
| **Liabilities** | | | | |
| **Current Liabilities:** | | | | |
| Accounts Payable | 60,000 | 30% | 75,000 | 30% |
| Unearned Revenue | 10,000 | 5% | 25,000 | 10% |
| **Total Current Liabilities** | 70,000 | 35% | 100,000 | 40% |
| **Noncurrent Liabilities:** | | | | |
| Notes Payable | 40,000 | 20% | 50,000 | 20% |
| **Total Liabilities** | $110,000 | 55% | $150,000 | 60% |
| **Stockholder Equity** | | | | |
| Common Stock | 75,000 | 38% | 80,000 | 32% |
| Ending Retained Earnings | 15,000 | 8% | 20,000 | 8% |
| **Total Stockholder Equity** | 90,000 | 45% | 100,000 | 40% |
| **Total Liabilities and Stockholder Equity** | $200,000 | 100% | $250,000 | 100% |

**Figure 18.5 Common-Size Balance Sheet**

## Income Statement Analysis

Like balance sheet analysis, income statement analysis is also quite helpful in preparing for the forecasting process. In Financial Statements, you learned that the income statement is commonly broken down into a few sections. Cost of goods sold is deducted from net sales to arrive at gross margin. Gross margin refers to the profits earned solely on the sale of the product itself, without consideration for the expenses incurred to run the business. Next, operating expenses are deducted to reflect operating income. Operating income reflects the profits of the core business function. Finally, other items, such as interest expense, tax expense, and other gains and losses, are deducted to arrive at net income, a.k.a. the *bottom line*. Each segment of the income statement is helpful for assessing past performance and estimating future expenses for a forecast.

You continued your financial statement development in Measures of Financial Health, where you saw how to

use elements of the income statement to assess historical financial performance. Ratios based on the income statement can be useful for understanding relationships between net sales and expenses—how they related in the past and then, in forecasting, how those relationships might change or remain the same. Examples of income statement ratios include gross margin, operating margin, and profit margin. Common ratios that incorporate items from both the balance sheet and the income statement include return on assets (ROA), return on equity (ROE), inventory turnover, accounts receivable turnover, and accounts payable turnover.

### LINK TO LEARNING

#### Performance Trends

Review the most recent annual report for Big 5 Sporting Goods (https://openstax.org/r/annual_report_for_Big_5_Sporting-Goods). Review the company's sales and gross margins for the current and past two years. How is their performance? Are their sales trending up or down? Why might the contribution margin have increased or decreased?

In Financial Statements, you also explored common-size analysis. To prepare a common-size analysis of the income statement, every item on the statement must be expressed as a percentage of net sales. Seeing each item as a percentage, in terms of its relationship to total sales, is also helpful for assessing historical statements and how those percentages or relationships can be used to predict future balances in the forecast. For example, in Figure 18.6, you can see that Clear Lake's cost of goods sold represented 50% of its net sales in both the current and prior years.

**Clear Lake Sporting Goods**
**Comparative Year-End Income Statements**

| | Prior Year | Prior Year %* | Current Year | Current Year %* |
|---|---|---|---|---|
| Gross Sales | $105,000 | | $126,000 | |
| Sales Returns & Allowances | 5,000 | | 6,000 | |
| Net Sales | 100,000 | 100% | 120,000 | 100% |
| Cost of Goods Sold | 50,000 | 50% | 60,000 | 50% |
| Gross Profit | 50,000 | 50% | 60,000 | 50% |
| Rent Expense | 5,000 | 5% | 5,500 | 5% |
| Depreciation Expense | 2,500 | 3% | 3,600 | 3% |
| Salaries Expense | 3,000 | 3% | 5,400 | 5% |
| Utility Expense | 1,500 | 2% | 2,500 | 2% |
| Operating Income | 38,000 | 38% | 43,000 | 36% |
| Interest Expense | 3,000 | 3% | 2,000 | 2% |
| Income Tax Expense | 5,000 | 5% | 6,000 | 5% |
| Net Income | $ 30,000 | 30% | $ 35,000 | 29% |

**Some figures are rounded to the nearest whole percent, which may alter the total percentage to plus or minus* 100%.

**Figure 18.6 Common-Size Income Statement**

# 18.2 Forecasting Sales

## Learning Outcomes

By the end of this section, you will be able to:

- Explain how sales are the main driver for a financial forecast.
- Determine a past time period to formulate the basis for a financial forecast.
- Explain the advantages and disadvantages of using past data to forecast future financial performance.
- Calculate past sales growth averages.
- Justify adjusting relationships when forecasting future financial performance.

In this section of the chapter, you will begin to explore the first step of creating a forecast: forecasting sales. We will discuss common time frames for sales forecasts and why we use historical data in our forecasts (but only with caution), and we will work through the process of forecasting future sales. We will be using the percent-of-sales method to forecast some expenses for Clear Lake Sporting Goods, the example used throughout the chapter. This method relies on sales data, further highlighting why accuracy in forecasting sales is crucial.

## Sales as the Driver

A significant portion of a business's costs are driven by how much it sells. Thus, the sales forecast is the necessary first step in preparing a financial forecast. Common costs driven by sales include direct product costs, direct labor costs, and other key variable costs (i.e., costs that vary proportionately to sales), such as sales commissions.

## Looking to the Past

Forecasting sales is not always an easy task, as no one knows the future. We can, however, use the information we do have to forecast future sales with the greatest accuracy possible. Most firms start by looking at the past. A firm may look at past sales from a variety of prior periods. It's common to look at the past 12 months to estimate the coming 12 months. Looking at 12 consecutive months helps identify seasonality of sales trends, what time of year sales tend to drop off and when they increase, possible sales spikes that might reoccur, and any other trends that tend to appear over a 12-month period. In Figure 18.7, we see Clear Lake's sales by month for the past 12 months.

Past data is often used in conjunction with probabilities and weighted average calculations derived from probabilities. Though used in several areas of forecasting, this approach is particularly common in drafting the sales forecast. Using multiple scenarios and the probability of each scenario occurring is a common approach to estimating future sales.

**Clear Lake Sporting Goods**
**Monthly Sales**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Current Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gross Sales | 9,000 | 11,000 | 9,000 | 10,000 | 14,000 | 19,000 | 18,000 | 12,000 | 8,000 | 6,000 | 5,000 | 5,000 | $126,000 |

**Figure 18.7 Historical Sales Data**

We can see at first glance that sales remain fairly steady from January to April. Sales then goes up significantly in April and May, seem to peak in June, taper off a bit in July, then decline steeply from August to the end of the year, with the lowest sales being in November and December. Though not exact, it's easy to quickly see that sales follow a seasonal pattern. We will focus on just one year of data here to keep things simple. However, it's important to note that when a firm has a seasonal sales pattern, it normally uses more than one year of data to detect and evaluate the pattern. It's not uncommon for firms to have a seasonal sales pattern that

fluctuates based on an external factor such as weather patterns, patterns in business or demand, or other factors such as holidays. Common examples might include farm-based businesses that function on a weather pattern for harvesting and selling crops or a toy company that fluctuates around gift-giving holidays.

This knowledge is helpful when assembling a first pass at the next year's sales forecast. Using common-size and horizontal (trend) analyses on sales is also helpful, as shown in Figure 18.8. We can see the exact percentages that sales went up or down each month:

- In January, the company had sales of $9,000, which was $7.1\%$ ($\$9.000/\$126,000$) of the total annual sales.
- In June, the company had $19,000 sales, which was $15.1$ ($\$19,000/\$126,000$) of the total annual sales and $211\%$ ($\$19,000/\$9,000$) of January sales.

**Clear Lake Sporting Goods**
**Monthly Sales as Percentages**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Current Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gross Sales | 9,000 | 11,000 | 9,000 | 10,000 | 14,000 | 19,000 | 18,000 | 12,000 | 8,000 | 6,000 | 5,000 | 5,000 | $126,000 |
| % of Annual Sales | 7.1% | 8.7% | 7.1% | 7.9% | 11.1% | 15.1% | 14.3% | 9.5% | 6.3% | 4.8% | 4.0% | 4.0% | 100.0% |
| % Change from January Baseline | 100% | 122% | 100% | 111% | 156% | 211% | 200% | 133% | 89% | 67% | 56% | 56% | |

**Figure 18.8 Historical Sales Data as Percentages**

Once a baseline in the 12-month period is assessed, it can also be helpful to look for trends in other ways. For example, the past several years might be assessed to see if there is a trend in total growth or decline for those years on a summary basis or by period. Clear Lake Sporting Goods had sales in the current year of $126,000, in the prior year of $105,000, and two years ago of $89,000. This reflects a 20% increase and an 18% increase, respectively. It might be reasonable to expect a roughly 18 to 20% increase in total sales in the future with only this information in mind. Keep in mind that we will learn about many other factors to consider in the forecast, so the 18 to 20% increase is a good general guideline to consider along with other factors.

## THINK IT THROUGH

### Sales Forecast for Big 5 Sporting Goods

Review the 2020 annual report for Big 5 Sporting Goods (https://openstax.org/r/2020_annual_report_for_Big_5_Sporting_Goods). Locate the consolidated statements of operations on page F-7. Using the company's net sales figures for the current and prior years, what percentage might you recommend for their sales forecast for the next year?

**Solution:**

Big 5's sales for 2020 and 2019 were $1,041,212,000 and $996,495,000, respectively. This represents a 4.5% growth from the prior year. Forecasted sales, based solely on this information, might be appropriate at 4.5% growth for the next year, keeping in mind that many other factors should also be considered along with this information. Historical sales are only one set of data to use as a starting point.

Looking at Figure 18.9, assume that Clear Lake Sporting Goods decides to take its first pass at a forecast using the more conservative estimate of 18% total sales growth. The company could consider last year's sales of $126,000 and increase them by 18% to arrive at total forecasted sales for next year of $\$148,680$ ($\$126,000 \times 118\%$). Next, to get the monthly sales, the company could use the same percent of the total for each month that it did for the previous year. For example, sales in January of last year were 7.1% of the full year's sales. To find the forecast for the next year, the company would take the forecasted sales of $148,680

for the year and multiply that by 7.1% to get $10,620 for January. The process is repeated for each month to get the full year.

| Clear Lake Sporting Goods<br>Forecasted Monthly Income Statements | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Next Year |
| Gross Sales | 10,620 | 12,980 | 10,620 | 11,800 | 16,520 | 22,420 | 21,240 | 14,160 | 9,440 | 7,080 | 5,900 | 5,900 | $148,680 |
| % of Annual Sales | 7.1% | 8.7% | 7.1% | 7.9% | 11.1% | 15.1% | 14.3% | 9.5% | 6.3% | 4.8% | 4.0% | 4.0% | 100.0% |
| % Change from January Baseline | 100% | 122% | 100% | 111% | 156% | 211% | 200% | 133% | 89% | 67% | 56% | 56% | |

**Figure 18.9 Forecasted Sales Data**

Keep in mind that this is only a starting point. These estimates will be reviewed, assessed, and updated as more information and other factors are taken into consideration.

It can also be helpful to look at a shorter period, perhaps just the last few months, on a more detailed basis (by department, by customer, etc.) to see if there are any possible new trends beginning to develop that might be an indicator of performance in the coming year. For example, Clear Lake Sporting Goods might look at detailed sales records for October, November, and December and see that it had an old product line that was discontinued in early October, which contributed to a 2% reduction in monthly sales. This reduction in monthly sales will likely continue into the new year until the new line the company has signed on begins arriving in stores. Thus, the management team feels they should reduce their first quarter monthly estimates by 2%, as reflected in Figure 18.10. January is now $\$10{,}408$ $(\$10{,}620 \times 98\%)$, for example.

| Clear Lake Sporting Goods<br>Forecasted Monthly Income Statements | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total |
| Gross Sales | 10,408 | 12,720 | 10,408 | 11,800 | 16,520 | 22,420 | 21,240 | 14,160 | 9,440 | 7,080 | 5,900 | 5,900 | $147,996 |

**Figure 18.10 Adjusted Forecasted Sales Data**

## Changes for the Future

It's important to note that the past is not always a reliable predictor of the future. Circumstances can often change to make the future quite different from the past. The business itself may change, the economy can change, the customer base may undergo a shift in demographics or a change in buying habits, new competition may emerge, and so on. So while past performance is helpful, it is only one step in the process of forecasting sales.

LINK TO LEARNING

### Big 5 Sporting Goods MD&A Report

Review the most recent annual report for Big 5 Sporting Goods (https://openstax.org/r/annual_report_for_Big_5_Sporting_Goods). Review the management's discussion and analysis (MD&A) report (Item 7). What information does the report share about the firm, the economy, and other factors that might be useful for forecasting sales growth for next year?

Most firms first look to the past to target some form of baseline estimate for the coming year; then, managers begin making adjustments based on what they know about the future. Assume that Clear Lake Sporting Goods will be adding a new brand to its collection of fishing supplies in March. The manufacturer plans to begin

running its commercials in late February, which managers anticipate will increase Clear Lake's monthly sales by about $500 in March, $1,000 in April, $1,400 in May, and $2,000 per month in June, July, and August. We see the monthly adjustments to Clear Lake's latest sales forecast in Figure 18.11. March, for example, is now $10,908 ($10,408 prior estimate plus $500 increase from new brand).

| Clear Lake Sporting Goods<br>Forecasted Monthly Income Statements | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total |
| Gross Sales | 10,408 | 12,720 | 10,908 | 12,800 | 18,020 | 24,420 | 23,240 | 16,160 | 9,440 | 7,080 | 5,900 | 5,900 | $156,996 |

**Figure 18.11 Forecasted Sales Data with New Brand**

What we have discussed here are only some brief examples of the myriad factors that might impact a sales budget for the coming year. It's critical that all members of the team take the time and effort to research their customers and the factors that impact their business in order to effectively assess the impact of these factors on future sales. Though only two adjustments were made here, it's likely that a large firm would have to consider many, many factors that would ultimately impact monthly sales figures before arriving at a conclusion.

# 18.3 Pro Forma Financials

## Learning Outcomes

By the end of this section, you will be able to:

- Define pro forma in the context of a financial forecast.
- Describe the factors that impact the length of a financial forecast.
- Explain the risks associated with a financial forecast.

In this section of the chapter, we will move beyond the sales forecast and look at the general nature, length, and timeline of forecasts and the risks associated with using them. We'll look at why we use them, how long they generally are, what the key variables in a forecast are, and how we pair those variables with common-size analysis to develop the forecast.

## Purpose of a Forecast

As mentioned earlier in the chapter, forecasts serve different purposes depending on who is using them. Our focus here, however, is the world of finance. In this realm, the key purpose of **pro forma** (future-looking) financial statements is to manage a firm's cash flow and assess the overall value that the firm is generating through future sales growth. Growing just for the sake of growing doesn't always yield favorable income for the firm. A larger top-line sales figure that results in lower net income doesn't make sense in the grand scheme of things. The same is true of profitable sales that don't generate enough cash flows at the right time. The firm may make a profit, but if it doesn't manage the timing of its cash flows, it could be forced to shut down if it can't cover the costs of payroll or keep the lights on. Forecasting helps assess both cash flow and the profitability of future growth. Managers can forecast cash flow using data from forecasted financial statements; this allows them to identify potential gaps in cash and plan ahead in order to either alter collection and payment policies or obtain funding to cover the gap in the timing of cash flows.

LINK TO LEARNING

### Pro Forma Financial Statements

Review the video Business Plan and Pro-Forma Financial Statements (https://openstax.org/r/Business_Plan_and_Pro-Forma_Financial_Statements) to learn about the basics of pro forma financial

statements and why they are helpful.

## Length of a Forecast

Forecasts can generally be for any length of time. The length generally depends on the user's needs. A one-year forecast, broken down by month, is quite typical. A firm will often go through a formal budgeting process near the end of its calendar or fiscal year to project financial plans and goals for the coming year. Once that is done, a rolling financial forecast is then done monthly to adjust as time moves on, more information becomes available, and circumstances change.

To be useful, the future forecast for financial planning purposes is almost always calculated as monthly increments rather than one total figure for the next 12 months. Breaking the data down by month allows finance managers to more clearly see fluctuations in cash flows in and out, identify potential gaps in cash flow, and plan ahead for their cash needs.

Forecasts can also be done for several years into the future. In fact, they commonly are. However, once the firm is looking out beyond 12 months, it gets difficult to forecast items with a great degree of accuracy. Often, forecasts beyond a year will be completed only to quarterly or even annual figures rather than monthly. Forecasts that far into the future are often strategic in nature, made more to communicate future plans for the firm than for more detailed decision-making and cash flow planning.

## Common-Size Financials

As we saw earlier in the chapter, common-size analysis involves using historical financial statements as a basis for future forecasts. Financial statements provide a great starting point for analysis, as we can see the relationships between sales and costs on the income statement and the relationships between total assets and line items on the balance sheet.

For example, in Figure 18.6, we saw that for the past two years, cost of goods sold has been 50% of sales. Thus, in the first draft of a forecast for Clear Lake, it's likely that managers would estimate cost of goods sold at 50% of their forecasted sales. We can begin to see why forecasting sales first is crucial and why doing so as accurately as possible is also important.

## Select Variables to Use

A simple way to begin a full financial statement forecast might be to simply use the common-size statements and forecast every item using historical percentages. It's a logical way to begin a very rough draft of the forecast. However, several variables should be taken into consideration. First, managers must address the cost of an account and determine if it's a variable or fixed item. Variable costs tend to vary directly and proportionally with production or sales volume. Common examples include direct labor and direct materials. Fixed costs, on the other hand, do not change when production or sales volume increases or decreases within the relevant range. Granted, if production were to increase or decrease by a large amount, fixed costs would indeed change. However, in normal month-to-month changes, fixed costs often remain the same. Common examples of fixed costs include rent and managerial salaries.

So, if we were to approach our common-size income statement, for example, we would likely use the percentage of sales as a starting point to forecast variable items such as cost of goods sold. However, fixed costs may not be accurately forecast as a percentage of sales because they won't actually change with sales. Thus, we would likely look at the history of the dollar values of fixed costs in order to forecast them.

CONCEPTS IN PRACTICE

### COVID-19 Makes Forecasting Difficult for Big 5 Sporting Goods

Big 5 Sporting Goods announced record earnings in the third quarter of 2020, attributing its huge success that quarter to the impact of people's reactions to the COVID-19 pandemic. With so many people in quarantine still wanting to make healthy lifestyle choices, sporting goods stores were making record sales. Record-breaking sales, however, are not certain in the future. The impacts of the pandemic are extremely difficult to predict, making it a challenge for Big 5 Sporting Goods and other companies to assemble pro forma financial statements.

(sources: https://www.globenewswire.com/news-release/2020/10/27/2115470/0/en/Big-5-Sporting-Goods-Corporation-Announces-Record-Fiscal-2020-Third-Quarter-Results.html; https://finance.yahoo.com/news/investors-want-big-5-sporting-054658521.html; https://www.cpapracticeadvisor.com/accounting-audit/news/21206691/four-ways-covid19-will-impact-2021-financial-forecasting-and-planning)

## Determine Potential Changes in Variables

So far, we have focused on using historical common-size statements to create a draft (not a final version) of the forecast. This is because the past isn't always a perfect indicator of the future, and our finances don't always follow a linear pattern. We use the past as a good starting point; then, we must assess what else we know to fine-tune and make adjustments to the forecast.

Many items impact the forecast, and they will vary from one organization to another. The key is to do research, gather data, and look around at the market, the economy, the competition, and any other factors that have the potential to impact the future sales, costs, and financial health of the company. Though certainly not an exhaustive list, here are a few examples of items that may impact Clear Lake Sporting Goods.

- It has an old product line that was discontinued in early October, contributing to a 2% reduction in monthly sales that will likely continue into the new year until a new line begins arriving in stores.
- It will be adding a new brand to its collection of fishing supplies in March. The manufacturer plans to begin running commercials in late February. Managers anticipate that this will increase Clear Lake's monthly sales by about $500 in March, $1,000 in April, $1,400 in May, and $2,000 per month in June, July, and August.
- The company has just finished updating its employee compensation package. It goes into effect in January of the new year and will result in an overall 4% increase in the cost of labor.
- The landlord indicated that rent will increase by $50 per month starting July 1.
- Some fixed assets will be fully depreciated by the end of March. Thus, depreciation expense will go down by $25 per month beginning in April.
- There are rumors of new regulations that will impact the costs of importing some of the more difficult-to-obtain hunting supplies. Managers aren't entirely sure of the full impact of the new legislation at this time, but they anticipate that it could increase cost of goods sold for the affected product line when the new legislation goes into effect in the last quarter. Their best estimate is that it could increase the overall cost of goods sold by up to 2%.

We will use all of this data later in the chapter when we are ready to compile a complete forecast for Clear Lake.

# 18.4 Generating the Complete Forecast

## Learning Outcomes

By the end of this section, you will be able to:

- Generate a forecasted income statement that incorporates pertinent sales, functional, and policy variables.
- Generate a forecasted balance sheet.
- Connect the balance sheet and income statement forecasts with appropriate feedback linkages.

In this section of the chapter, we will tie together what we have learned so far about forecasting sales, common-size analysis, and using what we know about the company and its environment to create a full set of pro forma (forward-looking or forecasted) financial statements.

## Forecast the Income Statement

To arrive at a fully forecasted income statement, we use historical income statements, common-size income statements, and any additional information we have about future sales and costs, such as the effects of the economy and competition. As we saw earlier in the chapter, we begin with forecasted sales because they are the basis for many of the forecasted costs.

Let's begin with the sales forecast for Clear Lake Sporting Goods that we saw earlier in the chapter, in Figure 18.9, and use it along with the prior year income statement by month shown in Figure 18.12. We will consider other data we have about the business to begin creating a full income statement (see Figure 18.13).

**Clear Lake Sporting Goods**
**Prior Year Monthly Income Statements**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Current Year | Current Year % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gross Sales | 9,000 | 11,000 | 9,000 | 10,000 | 14,000 | 19,000 | 18,000 | 12,000 | 8,000 | 6,000 | 5,000 | 5,000 | $126,000 | |
| % of Annual Sales | 7.1% | 8.7% | 7.1% | 7.9% | 11.1% | 15.1% | 14.3% | 9.5% | 6.3% | 4.8% | 4.0% | 4.0% | 100.0% | |
| % Change from January Baseline | 100% | 122% | 100% | 111% | 156% | 211% | 200% | 133% | 89% | 67% | 56% | 56% | | |
| Sales Returns & Allowances | 300 | 400 | 400 | 600 | 800 | 1,000 | 800 | 600 | 400 | 300 | 200 | 200 | 6,000 | |
| Net Sales | 8,700 | 10,600 | 8,600 | 9,400 | 13,200 | 18,000 | 17,200 | 11,400 | 7,600 | 5,700 | 4,800 | 4,800 | 120,000 | 100% |
| Cost of Goods Sold | 4,785 | 5,830 | 4,730 | 4,700 | 5,940 | 8,100 | 7,740 | 5,700 | 3,800 | 2915 | 2,880 | 2,880 | 60,000 | 50% |
| Gross Margin | 3,915 | 4,770 | 3,870 | 4,700 | 7,260 | 9,900 | 9,460 | 5,700 | 3,800 | 2,785 | 1,920 | 1,920 | 60,000 | 50% |
| Rent Expense | 458 | 458 | 458 | 458 | 458 | 458 | 458 | 458 | 458 | 458 | 458 | 458 | 5,500 | 5% |
| Depreciation Expense | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 3,600 | 3% |
| Salaries Expense | 450 | 450 | 450 | 450 | 450 | 450 | 450 | 450 | 450 | 450 | 450 | 450 | 5,400 | 5% |
| Utility Expense | 179 | 218 | 179 | 198 | 278 | 377 | 357 | 238 | 159 | 119 | 99 | 99 | 2,500 | 2% |
| Operating Income | 2,528 | 3,343 | 2,483 | 3,293 | 5,774 | 8,315 | 7,895 | 4,254 | 2,433 | 1,458 | 612 | 612 | 43,000 | 36% |
| Interest Expense | 167 | 167 | 167 | 167 | 167 | 167 | 167 | 167 | 167 | 167 | 167 | 167 | 2,000 | 2% |
| Income Tax Expense | 353 | 467 | 346 | 460 | 806 | 1,160 | 1,102 | 594 | 339 | 203 | 85 | 85 | 6,000 | 5% |
| Net Income | 2,009 | 2,710 | 1,970 | 2,667 | 4,802 | 6,988 | 6,626 | 3,493 | 1,927 | 1,088 | 360 | 360 | $ 35,000 | 29% |

**Figure 18.12 Prior Year Monthly Income Statement by Month**

The first two key points regarding product lines have already been built into the sales forecast. Notice that the cost of goods sold was 50% in the prior year. However, based on possible future legislation, to be conservative, we should increase the cost of goods sold by 2% in the last quarter of the year. Thus, we will forecast cost of goods sold at 50% of sales in the first nine months and increase it to 52% in the last three months of the year.

Rent is a fixed cost that historically amounts to $458 per month. However, we know that the landlord is increasing rent by $50 starting on July 1. Thus, we will forecast rent at the same fixed cost of $458 per month for the first six months and increase it to $508 per month for the second half of the year.

Depreciation, also a fixed cost, was historically $300 per month. However, we know that depreciation expense will go down by $25 beginning in April. Thus, we forecast depreciation at $300 for the first three months and at $275 for the last 9 months.

Salaries expense has historically been $450 per month. However, we know that the company is implementing a new compensation program on January 1 that will increase salaries expense by 4% ($18). Thus, we will forecast salaries for the whole year at $468.

Utilities expense seems to vary somewhat by sales from month to month, as shops are open longer hours during their busy season. However, the total utilities expense is not expected to change for the coming year. Thus, the forecast for utilities expense remains at $2,500, broken down by month as a percentage of sales.

Interest expense is a fixed cost and isn't anticipated to change. Thus, the same $167 interest expense per month is forecast for the coming year.

Finally, income tax expense is forecasted as a percentage of operating income because tax liability is incurred as a direct result of operating income. Figure 18.13 shows the next 12 months' forecast for Clear Lake Sporting Goods using all of this data.

**Clear Lake Sporting Goods**
**Forecasted Monthly Income Statements**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gross Sales | $10,408 | $12,720 | $10,908 | $12,800 | $18,020 | $24,420 | $23,240 | $16,160 | $9,440 | $7,080 | $5,900 | $5,900 | $156,996 |
| % of Annual Sales | 7.1% | 8.7% | 7.1% | 7.9% | 11.1% | 15.1% | 14.3% | 9.5% | 6.3% | 4.8% | 4.0% | 4.0% | 100% |
| % Change from January Baseline | 100% | 122% | 105% | 123% | 173% | 235% | 223% | 155% | 91% | 68% | 57% | 57% | |
| Sales Returns & Allowances | 300 | 400 | 400 | 600 | 800 | 1,000 | 800 | 600 | 400 | 300 | 200 | 200 | 6,000 |
| Net Sales | 10,108 | 12,320 | 10,508 | 12,200 | 17,220 | 23,420 | 22,440 | 15,560 | 9,040 | 6,780 | 5,700 | 5,700 | 150,996 |
| Cost of Goods Sold | 5,054 | 6,160 | 5,254 | 6,100 | 8,610 | 11,710 | 11,220 | 7,780 | 4,520 | 3,526 | 2,964 | 2,964 | 75,861 |
| Gross Margin | 5,054 | 6,160 | 5,254 | 6,100 | 8,610 | 11,710 | 11,220 | 7,780 | 4,520 | 3,254 | 2,736 | 2,736 | 75,134 |
| Rent Expense | 458 | 458 | 458 | 458 | 458 | 458 | 508 | 508 | 508 | 508 | 508 | 508 | 5,798 |
| Depreciation Expense | 300 | 300 | 300 | 275 | 275 | 275 | 275 | 275 | 275 | 275 | 275 | 275 | 3,375 |
| Salaries Expense | 468 | 468 | 468 | 468 | 468 | 468 | 468 | 468 | 468 | 468 | 468 | 468 | 5,616 |
| Utility Expense | 175 | 214 | 183 | 215 | 303 | 411 | 391 | 272 | 159 | 119 | 99 | 99 | 2,640 |
| Operating Income | 3,652 | 4,720 | 3,844 | 4,683 | 7,106 | 10,098 | 9,578 | 6,257 | 3,110 | 1,884 | 1,386 | 1,386 | 57,705 |
| Interest Expense | 167 | 167 | 167 | 167 | 167 | 167 | 167 | 167 | 167 | 167 | 167 | 167 | 2,000 |
| Income Tax Expense | 510 | 659 | 536 | 654 | 991 | 1,409 | 1,336 | 873 | 434 | 263 | 193 | 193 | 8,052 |
| Net Income | $ 2,976 | $ 3,895 | $ 3,141 | $ 3,863 | $ 5,948 | $ 8,522 | $ 8,075 | $ 5,218 | $2,510 | $1,455 | $1,026 | $1,026 | $ 47,653 |

**Figure 18.13 Forecasted Income Statement**

## Forecast the Balance Sheet

Now that we have a reasonable income statement forecast, we can move on to the balance sheet. The balance sheet, however, is entirely different from the income statement. It requires a bit more research and additional assumptions. Just like the income statement, it's often a work in progress. A first draft is a good starting point, but adjustments must be made once it is created, and all the interrelationships between the statements, cash flow in particular, are taken into consideration.

The balance sheet is a bit more difficult to forecast because the statement reflects balances at just a given point in time. Account balances change daily, so forecasting just one snapshot in time for each month can be a challenge. A good starting point is to assess general company financial policies or rules of thumb. For example, assume that Clear Lake pays most of its vendors on net 30-day terms. A good way to forecast accounts payable on the balance sheet might be to add up the cost of goods sold from the forecasted income statement for the prior month. For example, in Figure 18.14, we see that Clear Lake has forecasted its accounts payable for March as the cost of goods sold in March from its forecasted income statement.

For accounts receivable, Clear Lake generally receives payment from customers within net 90-day terms. Thus, it uses the sum of the current and prior two months' forecasted sales to estimate its accounts receivable balance.

Inventory will vary throughout the year. For the first six months, the company tries to build inventory for four months of sales. Once the busy season hits, inventory goes down to three months' worth of future sales, then finally drops to only two months of sales in December. Thus, managers use their sales forecast by month to

estimate their inventory ending balance each month.

The equipment balance is forecasted by reducing the prior month's balance by the forecasted depreciation expense on the forecasted income statement.

Unearned revenue is historically around 50% of the current month's sales. Thus, Clear Lake estimates its unearned revenue balance each month by taking the current month's net sales from the forecasted income statement and multiplying it by 50%.

Short-term investments, notes payable, and common stock are not anticipated to change, so the current balance is forecasted to remain the same for the next 12 months.

To forecast the ending balance for retained earnings for each month, managers add the monthly net income from the forecasted balance sheet to the prior balance and subtract a quarterly $10,000 dividend.

Once all of these accounts are completed, the balance sheet is out of balance. Given that all of these events are somewhat related but are not tied together dollar for dollar, it's not surprising when the forecasted balance sheet is finished and does not balance. To complete the first draft (see Figure 18.14), the cash account is used as a variable and plugged in to make the balance sheet balance. Notice that by the end of the year, the company has $59,905 in cash. However, look at what happens midyear—the cash account falls to only $8,782. In the next section, we will generate a cash flow forecast, which will allow Clear Lake to update its balance sheet forecast once it estimates what it will do to cover the cash flow gaps.

**Clear Lake Sporting Goods**
**Forecasted Monthly Balance Sheets**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Assets** | | | | | | | | | | | | |
| **Current Assets:** | | | | | | | | | | | | |
| Cash | $42,581 | $38,259 | $19,083 | $11,150 | $12,345 | $8,782 | $16,175 | $20,842 | $21,733 | $40,099 | $60,834 | $59,905 |
| Accounts Receivable | 25,408 | 32,028 | 37,736 | 45,136 | 52,248 | 63,348 | 75,280 | 78,640 | 70,460 | 53,820 | 37,080 | 27,220 |
| Inventory | 22,568 | 26,124 | 31,674 | 37,640 | 39,320 | 35,230 | 23,520 | 15,826 | 11,010 | 9,454 | 5,928 | 8,018 |
| Short-Term Investments | 20,000 | 20,000 | 20,000 | 20,000 | 20,000 | 20,000 | 20,000 | 20,000 | 20,000 | 20,000 | 20,000 | 20,000 |
| **Total Current Assets** | 110,557 | 116,411 | 108,493 | 113,925 | 123,913 | 127,360 | 134,975 | 135,308 | 123,202 | 123,373 | 123,842 | 115,142 |
| **Noncurrent Assets:** | | | | | | | | | | | | |
| Equipment | 50,000 | 49,700 | 49,400 | 49,100 | 48,825 | 48,550 | 48,275 | 48,000 | 47,725 | 47,450 | 47,175 | 46,900 |
| **Total Assets** | 160,557 | 166,111 | 157,893 | 163,025 | 172,738 | 175,910 | 183,250 | 183,308 | 170,927 | 170,823 | 171,017 | 162,042 |
| **Liabilities** | | | | | | | | | | | | |
| **Current Liabilities:** | | | | | | | | | | | | |
| Accounts Payable | 5,054 | 6,160 | 5,254 | 6,100 | 8,610 | 11,710 | 11,220 | 7,780 | 4,520 | 3,526 | 2,964 | 2,964 |
| Unearned Revenue | 2,527 | 3,080 | 2,627 | 3,050 | 4,305 | 5,855 | 5,610 | 3,890 | 2,260 | 1,695 | 1,425 | 1,425 |
| **Total Current Liabilities** | 7,581 | 9,240 | 7,881 | 9,150 | 12,915 | 17,565 | 16,830 | 11,670 | 6,780 | 5,221 | 4,389 | 4,389 |
| **Noncurrent Liabilities:** | | | | | | | | | | | | |
| Notes Payable | 50,000 | 50,000 | 50,000 | 50,000 | 50,000 | 50,000 | 50,000 | 50,000 | 50,000 | 50,000 | 50,000 | 50,000 |
| **Total Liabilities** | 57,581 | 59,240 | 57,881 | 59,150 | 62,915 | 67,565 | 66,830 | 61,670 | 56,780 | 55,221 | 54,389 | 54,389 |
| **Stockholder Equity** | | | | | | | | | | | | |
| Common Stock | 80,000 | 80,000 | 80,000 | 80,000 | 80,000 | 80,000 | 80,000 | 80,000 | 80,000 | 80,000 | 80,000 | 80,000 |
| Ending Retained Earnings | 22,976 | 26,871 | 20,012 | 23,875 | 29,823 | 28,345 | 36,420 | 41,638 | 34,147 | 35,602 | 36,628 | 27,653 |
| **Total Stockholder Equity** | 102,976 | 106,871 | 100,012 | 103,875 | 109,823 | 108,345 | 116,420 | 121,638 | 114,147 | 115,602 | 116,628 | 107,653 |
| **Total Liabilities and Stockholder Equity** | $160,557 | $166,111 | $157,893 | $163,025 | $172,738 | $175,910 | $183,250 | $183,308 | $170,927 | $170,823 | $171,017 | $162,042 |

**Figure 18.14 Forecasted Balance Sheet Draft**

## Linkages between the Forecasted Balance Sheet and the Income Statement

Notice that in the discussion in the prior section on the balance sheet forecast, a lot of the information in the forecasted income statement was used to generate the forecasted balance sheet. The balance sheet accounts generally depend on activity reported in the income statement. For example, for many firms, the balance in their accounts receivable account is tied to their sales. Looking at historical balances in the accounts receivable account and how those relate to historical sales will help determine how to use the forecasted future sales to estimate the future balance of accounts receivable.

The same is true of accounts payable. Looking at past balances, past expenses (normally cost of goods sold), and the firm's payment terms for its vendors allows managers to use forecasted cost of goods sold or other expenses to estimate the balance in the accounts payable account.

We learned in Financial Statements that net income flows into retained earnings. Thus, the net income from the forecasted income statement can be used to help estimate the ending balance in retained earnings. If the firm intends to issue any dividends in the coming year, managers should also estimate that reduction in their forecast.

It's also common to find other general policies or procedures that help drive performance and aid in forecasting balances. For example, if the company has a goal of maintaining a certain level of inventory or a minimum balance in its cash account, that information can be used to guide the estimate for those accounts.

# 18.5 Forecasting Cash Flow and Assessing the Value of Growth

## Learning Outcomes

By the end of this section, you will be able to:

- Generate a cash flow forecast.
- Assess a cash flow forecast to determine future cash funding needs.
- Use pro forma financial statements and cash flow forecasts to assess the value of growth to the firm.

In this section of the chapter, we will use the forecasted income statement, forecasted balance sheet, and other information we know about the firm's policies and goals for the coming year to generate and assess a cash flow forecast.

## Create a Cash Flow Forecast

A cash flow forecast isn't overly complex, yet it is not easy to assemble because it requires making many assumptions about the future. A **cash forecast** begins with the beginning cash balance, adds anticipated cash inflows, and deducts anticipated cash outflows. This identifies cash surpluses and shortages.

For Clear Lake Sporting Goods, for example, we see in Figure 18.15 that the company begins with cash of $42,581,000 in January of the new year. Next, it lists the cash inflows, or cash received from customers. Given the assumption that customers pay in 90-day terms, the cash flow is filled in by plugging in the sales forecast for the three prior months. For example, the cash flow from customers of $10,508 for June is the same as the net sales forecast for March (see Figure 18.13).

**Clear Lake Sporting Goods**
**Cash Forecast**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Beginning Cash Balance | $42,581 | $44,394 | $43,039 | $35,038 | $35,782 | $40,861 | $35,030 | $35,133 | $35,766 | $36,658 | $53,444 | $64,383 |
| **Cash Inflows**: | | | | | | | | | | | | |
| Accounts Receivable Collected | 5,700 | 4,800 | 4,800 | 10,108 | 12,320 | 10,508 | 12,200 | 17,220 | 23,420 | 22,440 | 15,560 | 9,040 |
| Total Cash Inflows: | $ 5,700 | $ 4,800 | $ 4,800 | $10,108 | $12,320 | $10,508 | $12,200 | $17,220 | $23,420 | $22,440 | $15,560 | $ 9,040 |

**Figure 18.15 Forecasted Cash Inflows**

Next, Clear Lake identifies cash outflows, which include accounts payable, salaries, rent, utilities, dividends, and interest payments. Accounts payable are normally paid within 30 days, so the forecast for cost of goods sold for the prior month is used as an estimate of amount paid for payables. For example, in Figure 18.16, we see that the accounts payable settled in June of $8,610 is the cost of goods sold for May from the forecasted income statement.

Salaries are paid monthly and thus represent the same recurring monthly cash outflow, as does rent. Utilities,

like accounts payable, are assumed to be paid within 30 days. Thus, the cash outflow for utilities is the utilities expense for the prior month from the forecasted income statement.

Management intends to pay a quarterly dividend of $10,000. Thus, in Figure 18.16, we see $10,000 cash outflows forecasted for March, June, September, and December. Interest on the long-term liability is paid quarterly. Thus, the $500 cash outflows in March, June, September, and December are simply the monthly interest expense of $167 from the income statement, summed for each quarter.

**Clear Lake Sporting Goods**
**Cash Forecast**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Beginning Cash Balance | $42,581 | $44,394 | $43,039 | $35,038 | $35,782 | $40,861 | $35,030 | $35,133 | $35,766 | $36,658 | $53,444 | $64,383 |
| **Cash Inflows**: | | | | | | | | | | | | |
| Accounts Receivable Collected | 5,700 | 4,800 | 4,800 | 10,108 | 12,320 | 10,508 | 12,200 | 17,220 | 23,420 | 22,440 | 15,560 | 9,040 |
| Total Cash Inflows: | 5,700 | 4,800 | 4,800 | 10,108 | 12,320 | 10,508 | 12,200 | 17,220 | 23,420 | 22,440 | 15,560 | 9,040 |
| **Cash Outflows:** | | | | | | | | | | | | |
| Accounts Payable Paid | 2,880 | 5,054 | 6,160 | 5,254 | 6,100 | 8,610 | 11,710 | 11,220 | 7,780 | 4,520 | 3,526 | 2,964 |
| Salaries | 450 | 468 | 468 | 468 | 468 | 468 | 468 | 468 | 468 | 468 | 468 | 468 |
| Rent | 458 | 458 | 458 | 458 | 458 | 458 | 508 | 508 | 508 | 508 | 508 | 508 |
| Utilities | 99 | 175 | 214 | 183 | 215 | 303 | 411 | 391 | 272 | 159 | 119 | 99 |
| Dividends | 0 | 0 | 10,000 | 0 | 0 | 10,000 | 0 | 0 | 10,000 | 0 | 0 | 10,000 |
| Interest Payments | 0 | 0 | 500 | 0 | 0 | 500 | 0 | 0 | 500 | 0 | 0 | 500 |
| Total Cash Outflows: | $ 3,888 | $ 6,155 | $17,800 | $ 6,364 | $ 7,242 | $20,339 | $13,097 | $12,587 | $19,528 | $ 5,655 | $ 4,621 | $14,539 |

**Figure 18.16 Forecasted Cash Inflows and Outflows**

## Using a Cash Forecast to Determine Additional Funds Needed

Finally, at the end of the cash flow forecast, cash outflows are subtracted from the cash inflows. This identifies whether a **cash surplus** (extra) or **cash deficit** (not enough) exists for each month. For example, in Figure 18.17, we see that in March, Clear Lake is forecasting $4,800 of cash inflows and $17,800 of total cash outflows, which results in a cash deficit of $13,000.

Clear Lake has a general policy to not let its cash balance fall below $35,000. Thus, managers need to assess their monthly balances and potential deficits and identify months when financing is necessary. For example, the deficit of $13,000 in March is enough to push the cash balance lower than $35,000. Thus, it's estimated that the company will need $5,000 in short-term financing in March. It has an estimated surplus in April, so $3,000 of the borrowing is returned.

**Clear Lake Sporting Goods**
**Cash Forecast**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Beginning Cash Balance | $42,581 | $44,394 | $43,039 | $35,038 | $35,782 | $40,861 | $35,030 | $35,133 | $35,766 | $36,658 | $53,444 | $64,383 |
| **Cash Inflows**: | | | | | | | | | | | | |
| Accounts Receivable Collected | 5,700 | 4,800 | 4,800 | 10,108 | 12,320 | 10,508 | 12,200 | 17,220 | 23,420 | 22,440 | 15,560 | 9,040 |
| Total Cash Inflows: | 5,700 | 4,800 | 4,800 | 10,108 | 12,320 | 10,508 | 12,200 | 17,220 | 23,420 | 22,440 | 15,560 | 9,040 |
| **Cash Outflows:** | | | | | | | | | | | | |
| Accounts Payable Paid | 2,880 | 5,054 | 6,160 | 5,254 | 6,100 | 8,610 | 11,710 | 11,220 | 7,780 | 4,520 | 3,526 | 2,964 |
| Salaries | 450 | 468 | 468 | 468 | 468 | 468 | 468 | 468 | 468 | 468 | 468 | 468 |
| Rent | 458 | 458 | 458 | 458 | 458 | 458 | 508 | 508 | 508 | 508 | 508 | 508 |
| Utilities | 99 | 175 | 214 | 183 | 215 | 303 | 411 | 391 | 272 | 159 | 119 | 99 |
| Dividends | 0 | 0 | 10,000 | 0 | 0 | 10,000 | 0 | 0 | 10,000 | 0 | 0 | 10,000 |
| Interest Payments | 0 | 0 | 500 | 0 | 0 | 500 | 0 | 0 | 500 | 0 | 0 | 500 |
| Total Cash Outflows: | 3,888 | 6,155 | 17,800 | 6,364 | 7,242 | 20,339 | 13,097 | 12,587 | 19,528 | 5,655 | 4,621 | 14,539 |
| Cash Surplus or Deficit | 1,812 | (1,355) | (13,000) | 3,744 | 5,079 | (9,832) | (897) | 4,633 | 3,892 | 16,785 | 10,939 | (5,499) |
| Short-Term Financing Borrowed (Repaid) | 0 | 0 | 5,000 | (3,000) | 0 | 4,000 | 1,000 | (4,000) | (3,000) | 0 | 0 | 0 |
| Ending Cash Balance | $44,394 | $43,039 | $35,038 | $35,782 | $40,861 | $35,030 | $35,133 | $35,766 | $36,658 | $53,444 | $64,383 | $58,884 |

**Figure 18.17 Forecasted Cash Surplus or Deficit**

## Assessing the Value of Growth

It's a fairly common assumption that most, if not all, businesses want to grow. While it certainly can be good as a firm to grow in size, growth just for the sake of growth isn't necessarily a good goal. A firm can grow in size based on customers, employees, locations, or simply sales. However, that doesn't mean that the growth will increase profits. Growth may increase profits, but this is not a safe assumption. Scaling up operations takes careful planning, which includes monitoring the profitability of the sales and, of course, the cash flow it would require. Growing a business can require more inventory, more locations, more equipment, and more manpower, all of which cost money. Even if the forecasted growth is profitable, it may pose problems from a cash flow perspective. It's important that the firm review not only its forecasted income statement and balance sheet but also its cash forecast, as this can reveal some serious gaps in funding depending on the extent, timing, and nature of the planned growth.

For example, assume that Clear Lake Sporting Goods intends to run a large-scale ad campaign to boost sales in its busy season. Historically, the store relied primarily on its prime location for high volumes of retail foot traffic. Managers felt, however, that given the increase in competition, they could boost sales significantly by running the ad campaign in the first quarter. The campaign would cost $30,000. Forecasts already reflect a cash deficit at the end of the first quarter of $13,000, so the additional $30,000 ad campaign, which would require payment up front, would create a much larger need for funding. It's also important that managers look at the increased cost of doing business along with the increased cost in advertising to ensure that the move would be profitable. Fortunately, Excel or other forecasting software can be used to create a forecast with formulas that tie together, making **scenario analysis** such as this a much easier process.

## Scenarios in Forecasting

Forecasting is almost never a linear process. In other words, we don't do one forecast and call it good. The first draft is completed using historical data, and then changes are made a bit at a time as all potential variables are assessed for their impact on the forecast. It's quite common to then use the work-in-progress forecast to complete scenario analysis. This is particularly true when the forecast is completed in Excel or other budgeting or forecasting software. Elements of the forecast can be changed to see what the overall impact would be to the firm. Assuming the forecast is set up using formulas in Excel or other software, a change to one figure or one variable would then "ripple" through the forecast to reflect the overall impact.

Often, a firm may complete an initial forecast (scenario) under the assumption that the economy is in a "normal state." The firm can then alter the initial forecast for different scenarios, such as the economy in a recession or the economy in a state of expansion. This helps the firm understand different possible future states and highlights how changes in the economy such as inflation may cause revenue and expenses to increase.

Assume that Clear Lake's initial forecast is created under the assumption that the economy will remain average. Management also wants to know the worst-case scenario. What will their financial results look like if the economy were in a recession, for example? If management assumes their sales would drop to only 60% of the prior year sales in a recessionary economy, they could alter the formula in Excel driving their sales and variable costs, resulting in a new pro forma income statement. In Figure 18.18, we can see that net income would drop to $16,391 under this assumption, compared to the net income of $47,653 forecasted under average economy assumptions in Figure 18.13.

**Clear Lake Sporting Goods**
**Forecasted Monthly Income Statements: Worst-Case Scenario**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gross Sales | $5,292 | $6,468 | $5,792 | $7,000 | $9,900 | $13,400 | $12,800 | $9,200 | $4,800 | $3,600 | $3,000 | $3,000 | $84,252 |
| % of Annual Sales | 7.1% | 8.7% | 7.1% | 7.9% | 11.1% | 15.1% | 14.3% | 9.5% | 6.3% | 4.8% | 4.0% | 4.0% | 100% |
| % Change from January Baseline | 100% | 122% | 109% | 132% | 187% | 253% | 242% | 174% | 91% | 68% | 57% | 57% | |
| Sales Returns & Allowances | 300 | 400 | 400 | 600 | 800 | 1,000 | 800 | 600 | 400 | 300 | 200 | 200 | 6,000 |
| Net Sales | 4,992 | 6,068 | 5,392 | 6,400 | 9,100 | 12,400 | 12,000 | 8,600 | 4,400 | 3,300 | 2,800 | 2,800 | 78,252 |
| Cost of Goods Sold | 2,496 | 3,034 | 2,696 | 3,200 | 4,550 | 6,200 | 6,000 | 4,300 | 2,200 | 1,716 | 1,456 | 1,456 | 39,304 |
| Gross Margin | 2,496 | 3,034 | 2,696 | 3,200 | 4,550 | 6,200 | 6,000 | 4,300 | 2,200 | 1,584 | 1,344 | 1,344 | 38,948 |
| Rent Expense | 458 | 458 | 458 | 458 | 458 | 458 | 508 | 508 | 508 | 508 | 508 | 508 | 5,798 |
| Depreciation Expense | 300 | 300 | 300 | 275 | 275 | 275 | 275 | 275 | 275 | 275 | 275 | 275 | 3,375 |
| Salaries Expense | 468 | 468 | 468 | 468 | 468 | 468 | 468 | 468 | 468 | 468 | 468 | 468 | 5,616 |
| Utility Expense | 175 | 214 | 192 | 231 | 327 | 443 | 423 | 304 | 159 | 119 | 99 | 99 | 2,786 |
| Operating Income | 1,095 | 1,594 | 1,278 | 1,767 | 3,021 | 4,556 | 4,326 | 2,745 | 790 | 214 | (6) | (6) | 21,373 |
| Interest Expense | 167 | 167 | 167 | 167 | 167 | 167 | 167 | 167 | 167 | 167 | 167 | 167 | 2,000 |
| Income Tax Expense | 153 | 222 | 178 | 247 | 422 | 636 | 604 | 383 | 110 | 30 | (1) | (1) | 2,982 |
| Net Income | $ 775 | $1,205 | $ 933 | $1,354 | $2,433 | $ 3,753 | $ 3,555 | $2,195 | $ 513 | $ 17 | $(172) | $(172) | $16,391 |

**Figure 18.18 Forecasted Cash Surplus or Deficit**

Though creating a full forecast in Excel can be a bit complex, it is a powerful tool that is useful for analysis. Elements can be used to vary just about anything, from something small such as a 1% increase in the cost of a product to a company-wide increase in salaries, the introduction of an entire new product line, or the purchase of a new production machine, among other possibilities.

For example, assume that Clear Lake has completed a first pass at its forecast and is reviewing the forecasted profit for the next 12 months. Managers feel the profit is currently low, as they always want to target a certain percentage. They might tinker with variables in the forecast file to see the impact on profits of potential changes they are considering. They may reduce the new salaries package by a percentage point to see if it gets them closer to their goal. They may adjust cost of goods sold by a certain percentage if they feel they can negotiate with vendors to work down their costs. They may adjust rent and see if they can find a better retail location to either reduce costs or increase sales due to increased foot traffic in a new location. They may save an entirely new version of the forecast and change it drastically to see what investing in opening a second retail location would do.

As you can see, the list of possibilities is endless. Though the main goal of financial managers may be cash planning, the power of a well-developed forecast is tremendous. It can help assess potential growth, new opportunities, and even small changes in the business as well.

## Sensitivity Analysis in Forecasting

**Sensitivity analysis** will often look at the change in just one variable rather than the entire scenario. It examines how sensitive a particular output (commonly net income) will be to a change in a particular underlying input (sales or costs, for example). What if sales are 10% more or less than forecasted? What if the prices the firm can charge its customers are 10% more or less? What if the cost of goods sold increases by 10%? The purpose is to see which variables are crucial to "get right." It isn't worth spending a lot of research dollars to make sure you are accurately predicting a variable if that variable won't notably change the outcome. However, a slight change in other variables may have significant impact.

Using pro forma financial statements created in Excel allows management to quickly generate new pro forma financials and see the impact that each possible variable might have on the overall financial results.

# 18.6 Using Excel to Create the Long-Term Forecast

## Learning Outcomes

By the end of this section, you will be able to:

- Generate a financial statement forecast using spreadsheet tools.
- Connect the balance sheet and income statement using appropriate formula referencing.
- Use spreadsheet functions to generate appropriate iterations that balance financial forecasts.

Throughout this chapter, we have seen forecasted financial statements for Clear Lake Sporting Goods along with its forecasted cash flow. These statements could all have been generated by hand, of course, but that wouldn't be an effective use of time. As mentioned in prior sections, several different types of software can be quite effective in making the forecasting process faster and more flexible. In this section, we will review just one common option, Microsoft Excel.

*Download the spreadsheet file (https://openstax.org/r/spreadsheet_file) containing key Chapter 18 Excel exhibits.*

## Using the "Sheet"

Creating a budget in Excel can be very simple or extremely complex, depending on the size and complexity of the business and the number of formulas and dependencies that are written into the Excel workbook.

Creating the forecast in Excel follows the same steps and flow we just explored in this chapter but with the power of a software program to do the math for you. We begin with the sales forecast, which uses several key formulas in Excel.

1. First, sales are projected to be 18% higher than the prior year. Thus, a total projection for the year is calculated using a simple link and multiplication function tied to last year's total sales. In Figure 18.19, you can see the formula in cell O4 is "='Figure 18.12'!N4*1.18". This formula simply does the math to increase the prior year's sales by 18%.
2. Next, the sales are distributed by month. In Figure 18.19, we see in cell B5 that the forecasted income statement sheet is linked to the percent of annual sales from the Prior Year Income Statement (Figure 18.12) sheet. Then, in cell B4, January sales are estimated with a formula that multiplies the total forecasted sales in O4 by the percent of annual sales for January of the prior year. Notice that the formula then multiplies that product by 0.98. This is because Clear Lake discontinued a product line in the last quarter of the prior year, and management feels that this will reduce sales in the first quarter of the new year by roughly 2%.

| | A | B | O |
|---|---|---|---|
| 1 | **Clear Lake Sporting Goods** | | |
| 2 | **Forecasted Monthly Income Statements** | | |
| 3 | | **Jan** | **Next Year** |
| 4 | Gross Sales | =($O4*B5)*0.98 | ='Figure 18.12'!N4*1.18 |
| 5 | % of Annual Sales | ='Figure 18.12'!B5 | =O4/$O4 |

**Figure 18.19 Forecasted Sales Formulas in Excel**

3. As Clear Lake continues to fill out its forecasted income statement, the next formula we see is a simple sum formula to calculate net sales in B8 (see Figure 18.20). It's a simple formula that subtracts sales returns and allowances in B7 from gross sales in B4. Similar formulas are also found in B10 for gross margin and B18 for net income.

4. In cell B9, we see a multiplication formula that multiplies sales from B4 by 0.5, or 50%. This is because management feels that cost of goods sold will remain the same as last year, in most quarters at least, and last year's percentage was 50%.
5. Rent, depreciation, and salaries are all simply typed in, as they are fixed expenses that remain the same as last year.
6. The utilities calculation, found in cell B14, is somewhat similar to the sales calculation. The total utilities expense from O14 is multiplied by the current month's sales in B4 divided by the total annual sales in O4. This spreads out the utility cost by month based on the percentage of annual sales.

| | A | B |
|---|---|---|
| 3 | | **Jan** |
| 4 | Gross Sales | =($O4*B5)*0.98 |
| 5 | % of Annual Sales | ='Figure 18.12'!B5 |
| 6 | % Change from January Baseline | =B4/$B4 |
| 7 | Sales Returns & Allowances | 300 |
| 8 | Net Sales | =B4-B7 |
| 9 | Cost of Goods Sold | =B8*0.5 |
| 10 | Gross Margin | =B8-B9 |
| 11 | Rent Expense | 458 |
| 12 | Depreciation Expense | 300 |
| 13 | Salaries Expense | 468 |
| 14 | Utility Expense | =$O14*(B4/$O4) |
| 15 | Operating Income | =B10-SUM(B11:B14) |
| 16 | Interest Expense | =2000/12 |
| 17 | Income Tax Expense | =$O17*(B15/$O15) |
| 18 | Net Income | =B15-B16-B17 |

**Figure 18.20 Forecasted Income Statement Formulas**

Clear Lake's forecasted balance sheet ties very closely to both the forecasted income statement and the prior year's income statement. In Figure 18.21, we see in C7 an addition formula using the sum of the current month and three months of prior sales as an estimate of the ending accounts receivable balance. The formula for inventory is similar but forward looking. In C8, inventory is estimated by adding the cost of goods sold for the current month and next three months from the forecasted income statement.

Total current assets in C10 is calculated with a SUM formula that adds together the values in all the selected cells. Amounts such as short-term investments and common stock that are not anticipated to change are simply typed as a number in the cell. Much like in the income statement, subtotals are found in C13 for total assets, C17 for current liabilities, C24 for total equity, and C25 for total liabilities and equity. Retained earnings

in C23 pulls the ending retained earnings balance from the end of last year (hidden in column B) and adds the net income for January in the forecasted income statement to get the current month's ending balance.

| | A | C |
|---|---|---|
| 3 | | **Jan** |
| 4 | **Assets** | |
| 5 | **Noncurrent assets:** | |
| 6 | Cash | 42581.4534883721 |
| 7 | Accounts Receivable | ='Figure 18.13'!B8+'Figure 18.12'!M8+'Figure 18.12'!L8+'Figure 18.12'!K8 |
| 8 | Inventory | ='Figure 18.13'!B9+'Figure 18.13'!C9+'Figure 18.13'!D9+'Figure 18.13'!E9 |
| 9 | Short -Term Investments | 20000 |
| 10 | **Total Current Assets** | =SUM(C6:C9) |
| 11 | **Noncurrent Assets:** | |
| 12 | Equipment | 50000 |
| 13 | **Total Assets** | =C10+C12 |
| 14 | **Current Liabilities:** | |
| 15 | Accounts Payable | ='Figure 18.13'!B9 |
| 16 | Unearned Revenue | =0.25*'Figure 18.13'!B8 |
| 17 | **Total Current Liabilities** | =C15+C16 |
| 18 | **Noncurrent Liabilities:** | |
| 19 | Notes Payable | 50000 |
| 20 | **Total Liabilities** | =C17+C19 |
| 21 | **Stockholder Equity** | |
| 22 | Common Stock | 80000 |
| 23 | Ending Retained Earnings | =B23+'Figure 18.13'!B18 |
| 24 | Total Stockholder's Equity | =C22+C23 |
| 25 | **Total Liabilities and Stockholder Equity** | =C24+C20 |

**Figure 18.21 Forecasted Balance Sheet Formulas**

Much like the balance sheet, the cash forecast also relies heavily on data from the forecasted income statement as well as the forecasted balance sheet. To begin the year, in Figure 18.22, we see that the formula in B4 pulls the cash balance from the forecasted balance sheet. In B6, the formula pulls the sales for the three months prior from the previous year's income statement. This is because it's assumed that cash is collected from customers 90 days after the sale. The same approach is used for accounts payable, rent, salaries, and utilities. The formulas pull the expenses from a prior month depending on the assumed timing for payment. Utilities, for example, are assumed to be paid within 30 days, so the cash outflow in February is assumed to be the utilities expense for January from the forecasted income statement. Note that interest payments are assumed to be zero in January and February, but in March, the formula in D14 sums the interest expenses on the forecasted income statement for January, February, and March. This is because interest is paid quarterly.

Finally, note the formula in C4. The beginning cash balance for a given month is the same as the ending cash balance from the prior month; thus, the figure in B18 is linked to C4 to start the new month.

| | A | B | C | D |
|---|---|---|---|---|
| 3 | | **Jan** | **Feb** | **Mar** |
| 4 | Beginning Cash Balance | ='Figure 18.21'!C6 | =B18 | =C18 |
| 5 | **Cash Inflows:** | | | |
| 6 | Accounts Receivable Collected | ='Figure 18.12'!K8 | ='Figure 18.12'!L8 | ='Figure 18.12'!M8 |
| 7 | Total Cash Inflows: | =SUM(B6:B6) | =SUM(C6:C6) | =SUM(D6:D6) |
| 8 | **Cash Outflows:** | | | |
| 9 | Accounts Payable paid | ='Figure 18.12'!M9 | ='Figure 18.13'!B9 | ='Figure 18.13'!C9 |
| 10 | Salaries | ='Figure 18.12'!M13 | ='Figure 18.13'!B13 | ='Figure 18.13'!C13 |
| 11 | Rent | ='Figure 18.13'!B11 | ='Figure 18.13'!C11 | ='Figure 18.13'!D11 |
| 12 | Utilities | ='Figure 18.12'!M14 | ='Figure 18.13'!B14 | ='Figure 18.13'!C14 |
| 13 | Dividends | 0 | 0 | 10000 |
| 14 | Interest Payments | 0 | 0 | =SUM('Figure 18.13'!B |
| 15 | Total Cash Outflows: | =SUM(B9:B14) | =SUM(C9:C14) | =SUM(D9:D14) |
| 16 | **Cash surplus or deficit** | =B7-B15 | =C7-C15 | =D7-D15 |
| 17 | Short term financing borrowed (repaid) | 0 | 0 | 5000 |
| 18 | Ending Cash Balance | =B4+B16+B17 | =C4+C16+C17 | =D4+D16+D17 |

**Figure 18.22 Cash Forecast Formulas**

## Using Excel Functions to Balance

Once we get a draft of the forecasts outlined, then the tinkering starts. Additional information can be used to adjust the formulas, as we saw with the 2% reduction in January sales for the forecasted income statement. Because we have linked most (though not all) of our expenses, subtotals, and statements together using formulas, management can also use the forecast workbook to perform scenario and sensitivity analyses, essentially asking “what if?” and looking at the results. When completed, however, before finalizing the forecast, it’s important that the financial statements are in balance (particularly the *balance sheet*, just as the name implies).

Notice that throughout, we used formulas to calculate subtotals to ensure they are correct and change as needed. We also linked figures, such as the ending and beginning cash balances, to ensure they are in balance. Perhaps the easiest but most important thing to do is to ensure that the balance sheet balances. We can do this with a simple formula that compares total assets to total liabilities and equity. We can see in Figure 18.23 that subtracting one from the other in cell C27 should result in $0. If there is a difference, the formula will highlight it, forcing us to investigate and correct the sheet so that it balances.

| | A | C |
|---|---|---|
| 10 | **Total Current Assets** | =SUM(C6:C9) |
| 11 | **Noncurrent Assets:** | |
| 12 | Equipment | 50000 |
| 13 | **Total Assets** | =C10+C12 |
| 14 | **Current Liabilities:** | |
| 15 | Accounts Payable | ='Figure 18.13'!B9 |
| 16 | Unearned Revenue | =0.25*'Figure 18.13'!B8 |
| 17 | **Total Current Liabilities** | =C15+C16 |
| 18 | **Noncurrent Liabilities:** | |
| 19 | Notes Payable | 50000 |
| 20 | **Total Liabilities** | =C17+C19 |
| 21 | **Stockholder Equity** | |
| 22 | Common Stock | 80000 |
| 23 | Ending Retained Earnings | =B23+'Figure 18.13'!B18 |
| 24 | Total Stockholder's Equity | =C22+C23 |
| 25 | **Total Liabilities and Stockholder Equity** | =C24+C20 |
| 26 | | |
| 27 | **Balance** | =C13-C25 |

**Figure 18.23 Forecasted Balancing Formula**

# Summary

## 18.1 The Importance of Forecasting

Forecasting financial statements is important to different users for different reasons. In finance, it's most important for assessing the value of future growth plans and planning for future cash flow needs.

## 18.2 Forecasting Sales

The sales forecast is the foundation on which much of the rest of the forecast is built. Thus, the sales forecast is completed first. Historical sales data and any other information on the firm, its products, the economy, its customers, and its competitors are all used to create the most accurate sales forecast possible.

## 18.3 Pro Forma Financials

Pro forma financial statements are forward looking in nature. They use the sales forecast, historical data, financial statement analyses, relationships between accounts and statements, and any other information known about the firm, the environment, and the future to create the most accurate financial statement forecast possible.

## 18.4 Generating the Complete Forecast

Interrelationships among historical data, the forecasted income statement, and the forecasted balance sheet are all used to estimate each line item in the financial statements.

## 18.5 Forecasting Cash Flow and Assessing the Value of Growth

Once the income statement and balance sheet forecasts are complete, data from those statements, information on company policies, and account relationships are used to generate a cash forecast. The cash forecast is important for identifying any gaps in cash flow so that financial managers can plan for cash needs. It's also important to review not only the cash forecast but all forecasted financial statements to assess the overall impact and value of proposed firm growth.

## 18.6 Using Excel to Create the Long-Term Forecast

Excel can be a powerful tool for creating financial forecasts. Formulas that complete mathematical functions and tie accounts and financial statements together are used to create the statements, ensure that they balance, and facilitate scenario and sensitivity analyses.

# Key Terms

**balance sheet** a financial statement that reflects a firm's asset, liability, and equity account balances at a given point in time

**cash deficit** an excess of cash outflows over cash inflows for a given period

**cash forecast** a financial statement that estimates a firm's future cash inflows and outflows

**cash surplus** an excess of cash inflows over cash outflows for a given period

**common-size** describes a financial statement in which each element is expressed as a percentage of a base amount

**financing activities** cash business transactions reported on the statement of cash flows that reflect the use of financed funds

**forecast** an estimate of future performance based on historical performance and other contextual information

**income statement** a financial statement that measures a firm's financial performance over a given period of time

**investing activities** cash business transactions reported on the statement of cash flows that reflect the acquisition or disposal of long-term assets

**operating activities** cash business transactions reported on the statement of cash flows that relate to ongoing day-to-day operations
**pro forma** in the context of financial statements, forward-looking
**scenario analysis** analysis of how various situations and circumstances would impact the financial forecast
**sensitivity analysis** analysis of the sensitivity of an output variable to a change in an input variable
**statement of cash flows** a financial statement that lists a firm's cash inflows and outflows over a given period of time
**statement of stockholders' equity** a financial statement that reports the difference between the beginning and ending balances of each of the stockholders' equity accounts during a given period

## Multiple Choice

1. Which type of financial statement analysis is most commonly used to create a baseline estimate for a financial forecast?
   **a.** Trend analysis
   **b.** Common-size analysis
   **c.** Ratio analysis
   **d.** Liquidity analysis

2. What key element of the income statement is used to estimate several other key income statement lines?
   **a.** Cost of goods sold
   **b.** Gross margin
   **c.** Sales
   **d.** Fixed costs

3. Jamal wants to forecast sales for the first quarter of next year. His first assumption is that sales will likely grow by 3% in the coming year. If Jamal's monthly sales were $10,000, $9,000, and $11,000 in the first quarter of this year, what should his sales forecast be for the first quarter of next year?
   **a.** $30,000
   **b.** $30,900
   **c.** $33,000
   **d.** $33,500

4. In the context of a firm's financial statements, what does *pro forma* mean?
   **a.** Forward looking
   **b.** Historical
   **c.** Board approved
   **d.** Audited

5. What is the most common length of a forecast if the goal is to forecast cash and assess possible short-term growth?
   **a.** 3 months
   **b.** 12 months
   **c.** 3 years
   **d.** 5 years

6. When completing a first pass at a forecasted income statement, which type of costs are assumed to be tied directly to sales?
   **a.** Fixed costs
   **b.** Period costs
   **c.** Variable costs
   **d.** Sunk costs

7. In the cash forecast, if cash inflows exceed cash outflows, what does this create?

**a.** A cash surplus
**b.** A cash deficit
**c.** A long-term liability
**d.** An undeclared dividend

8. Amelia wants to use a formula in Excel to estimate her utilities expense for each month. She normally pays her utilities within 30 days. What formula or link might she use in Excel to estimate her cash outflow for utilities?
   **a.** Sum the past three months' cost of goods sold from the forecasted income statement
   **b.** Link to the prior month's accounts payable from the forecasted balance sheet
   **c.** Link to the prior month's utilities expense from the forecasted balance sheet
   **d.** Link to the prior month's ending cash balance from the cash flow forecast

9. Amelia wants to use a formula in Excel to estimate her sales for each month. She believes her sales for the next year will be about 7% higher than this year's. She also has a big new ad campaign running late this year that she thinks will add another $5,000 to January sales. Which of the following is an appropriate Excel formula for Amelia's January sales?
   **a.** =(lastyearsalesA2*1.07)+5000
   **b.** =(lastyearsales+5000*1.07)
   **c.** =lastyearsalesA2+5000*.07
   **d.** =lastyearsalesA2*5000*1.07

## Review Questions

1. Javier's firm has created a forecasted income statement that shows the firm with a net profit of $25,000 for the coming year. What can we assume about Javier's cash flows?

2. Lulu's firm's sales grew by 9%, 11%, and 10% over the past three years, respectively. Lulu wants to take her first pass at forecasting sales for next year. What percent sales growth would you recommend she use, and why?

3. Aria wants to create a set of pro forma financial statements. Her goal is to plan for future cash flows and operations as well as help envision her long-term strategy. What time frames should Aria consider for her operations and cash flows versus her long-term strategy?

4. What information might you use to calculate the ending balance for retained earnings on a forecasted balance sheet?

5. Damon estimates his beginning cash balance for June to be $10,000, with cash inflows of $4,000 and cash outflows of $6,000 for the month. What is Damon's forecasted ending balance for June?

6. Tanneh wants to use an Excel formula to help her estimate sales for January in her forecasted income statement. She already has her sales estimate for the full year. Assuming she wants to use the past year's income statement percentages to forecast next year's sales, how would she calculate estimated sales for January?

## Problems

1. ABC Company has the following data for its monthly sales. Complete the % of Annual Sales row.

**ABC Company**
**Monthly Income Statements**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gross Sales | $40,000 | $42,000 | $47,000 | $56,000 | $60,000 | $71,000 | $53,000 | $53,000 | $46,000 | $37,000 | $39,000 | $31,000 | **$575,000** |
| % of Annual Sales | | | | | | | | | | | | | |

2. Using the same data as in Problem 1, assume that ABC Company expects a 10% increase in sales in the coming year (10% more than the $575,000 it had in the past year). Prepare its sales forecast, assuming the company breaks its sales down by month using the same percentages as the actual sales from the past year, which you calculated in the first problem.

| ABC Company<br>Monthly Income Statements | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Total** |
| Gross Sales | | | | | | | | | | | | | |
| % of Annual Sales | | | | | | | | | | | | | |

3. ABC Company anticipates its sales being a bit lower than normal in January and February of the coming year due to major road construction on the street where it is located, which will draw away foot traffic from the store. The company anticipates that this will reduce its sales in these two months by 5%. Use the information from Problems 1–2 to update the sales forecast.

4. ABC Company's cost of goods sold last year was 60%. It anticipates that this will be the same in the coming year. Its sales returns and allowances are small, normally 1% of sales. Use the information from Problems 1–3 to estimate the company's sales returns and allowances, net sales, and cost of goods sold and calculate its gross margin.

| ABC Company<br>Monthly Income Statements | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Total** |
| Gross Sales | $41,800 | $43,890 | $51,700 | $61,600 | $66,000 | $78,100 | $58,300 | $58,300 | $50,600 | $40,700 | $42,900 | $34,100 | **$627,990** |
| % of Annual Sales | 7.0% | 7.3% | 8.2% | 9.7% | 10.4% | 12.3% | 9.2% | 9.2% | 8.0% | 6.4% | 6.8% | 5.4% | **100.0%** |
| Sales Returns & Allowances | | | | | | | | | | | | | |
| Net Sales | | | | | | | | | | | | | |
| Cost of Goods Sold | | | | | | | | | | | | | |
| Gross Margin | | | | | | | | | | | | | |

5. Use the partial income statement generated in Problem 4 along with the following additional information to complete ABC Company's forecasted income statement in Excel.
   a. Rent expense is $1,000 per month. However, the landlord has indicated that rent will go up to $1,250 in the fourth quarter.
   b. Depreciation expense is $2,250 per month and does not change throughout the year.
   c. Salaries expense is $1,500 per month and is expected to go up by 10% in the second half of the year, when a new compensation plan will be implemented.
   d. Utilities expense is $5,000 for the entire year and should be allocated to each month based on that month's percentage of annual sales.
   e. Interest expense is $500 per month.
   f. Income tax is 25% of operating income less interest expense.

| ABC Company<br>Monthly Income Statements | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Total** |
| Gross Sales | $41,800 | $43,890 | $51,700 | $61,600 | $66,000 | $78,100 | $58,300 | $58,300 | $50,600 | $40,700 | $42,900 | $34,100 | **$627,990** |
| % of Annual Sales | 7.0% | 7.3% | 8.2% | 9.7% | 10.4% | 12.3% | 9.2% | 9.2% | 8.0% | 6.4% | 6.8% | 5.4% | **100.0%** |
| Sales Returns & Allowances | $ 418 | $ 439 | $ 517 | $ 616 | $ 660 | $ 781 | $ 583 | $ 583 | $ 506 | $ 407 | $ 429 | $ 341 | **$ 6,280** |
| Net Sales | 41,382 | 43,451 | 51,183 | 60,984 | 65,340 | 77,319 | 57,717 | 57,717 | 50,094 | 40,293 | 42,471 | 33,759 | **621,710** |
| Cost of Goods Sold | 24,829 | 26,071 | 30,710 | 36,590 | 39,204 | 46,391 | 34,630 | 34,630 | 30,056 | 24,176 | 25,483 | 20,255 | **373,026** |
| Gross Margin | 16,553 | 17,380 | 20,473 | 24,394 | 26,136 | 30,928 | 23,087 | 23,087 | 20,038 | 16,117 | 16,988 | 13,504 | **248,684** |
| Rent Expense | | | | | | | | | | | | | |
| Depreciation Expense | | | | | | | | | | | | | |
| Salaries Expense | | | | | | | | | | | | | |
| Utility Expense | | | | | | | | | | | | | |
| Operating Income | | | | | | | | | | | | | |
| Interest Expense | | | | | | | | | | | | | |
| Income Tax Expense | | | | | | | | | | | | | |
| Net Income | | | | | | | | | | | | | |

# Video Activity

## What Is a Pro Forma?

Access multimedia content (http://openstax.org/books/principles-finance/pages/18-video-activity)

1. What is a pro forma financial statement? What are some scenarios in which you might find a pro forma financial statement helpful?
2. Why might someone compile a pro forma financial statement that is intentionally inaccurate? What factors contribute to the accuracy of a pro forma?

## Cash Flow Forecasting Explained: How to Complete a Cash Flow Forecast Example

Access multimedia content (http://openstax.org/books/principles-finance/pages/18-video-activity)

3. Assume you are the financial manager for a large electronics retailer. What benefits could you gain from preparing a cash forecast?
4. Assume you are the financial manager for a large electronics retailer. You are going to prepare a cash forecast. What key cash inflows and outflows do you anticipate will be in your forecast?

19

# The Importance of Trade Credit and Working Capital in Planning

**Figure 19.1** Working capital describes the resources that are needed to meet the daily, weekly, and monthly operating cash flow needs. (credit: modification of "Sealey Power Products Warehouse" by Mark Hunter/flickr, CC BY 2.0)

## Chapter Outline


**19.1** What Is Working Capital?
**19.2** What Is Trade Credit?
**19.3** Cash Management
**19.4** Receivables Management
**19.5** Inventory Management
**19.6** Using Excel to Create the Short-Term Plan


## Why It Matters

During the COVID-19 pandemic, many families and small businesses realized the importance of financial resiliency. In personal finance, financial resiliency is the ability to overcome financial difficulties such as sudden job loss or significant unexpected expenses—to spring back quickly.

To help promote resiliency, personal financial planners advise clients to maintain liquid assets equal to three to six months of living expenses, keep debt levels low, manage the household budget, keep insurance in force (health, property, and life), establish a solid credit history, and make wise use of credit cards and home equity lines of credit.

In business finance, financial resiliency is not important only during pandemics but is important through the ups and downs of seasonal cycles and economic downturns. Managing cash, accounts receivable, and inventory while making optimal use of trade credit (accounts payable) makes for a business that meets its operating needs and pays its debts when due.

Working capital management is also critical during good times. Even though profits might be rising, a business with growing demand for its products and services still needs to have working capital management tools to pay its bills. Growth in sales and profits do not immediately mean sufficient cash flow, so planning ahead with tools such as a cash budget is key.

# 19.1 What Is Working Capital?

By the end of this section, you will be able to:

- Define working capital.
- Calculate a firm's operating cycle and cash cycle.
- Compute inventory days, accounts receivable days, and accounts payable days.

The concept of business capital is often associated with the cash and assets (such as land and equipment) that the owners contributed to the business. Early political economists like Adam Smith and Karl Marx identified this concept of capital, along with labor and entrepreneurship, to be the factors of production.

That general idea of capital is important and critical to a company's productive capacity. This chapter is about a specific type of capital— **working capital**—that is just as important as long-term capital. Working capital describes the resources that are needed to meet the daily, weekly, and monthly operating cash flow needs. Employees are paid out of working capital as well as cash from operations, the fulfillment of merchandise orders is possible because of working capital, and the liquidity of a company hinges upon how well management plans and controls working capital.

Understanding working capital begins with the concept of **current assets**—those resources of a business that are cash, near cash, or expected to be turned into cash within a year through the normal operations of the business. Current assets are necessary for the everyday operation of the firm, and they are synonymous with term **gross working capital**.

Cash is needed to pay the bills and meet the payroll. Excess cash is invested in cash alternatives such as **marketable securities**, creating **liquidity** that can be tapped when operating cash flow needs exceed the amount of cash on hand (checking account balances). Investment in inventory is necessary to meet the demand for products (sales), and if the firm extends credit to its customers so that a sale can be made, the balance sheet will also show accounts receivable—a very common current asset that derives its value from the probability that customers will pay their bills.

Working capital is often spoken about in two versions: *gross working capital* and *net working capital*. As was previously stated, gross working capital is equivalent to current assets, particularly those that are cash, cash-like, or will be converted to cash within a short period of time (i.e., in less than one year).

Net working capital (NWC) is a more refined concept of working capital. It is best understood by examining its formula:

$$\text{Current Assets} - \text{Current Liabilities} = \text{Net Working Capital} \tag{19.1}$$

## Goal of Working Capital Management

The goal of working capital management is to maintain adequate working capital to

- meet the operational needs of the company;
- satisfy obligations (current liabilities) as they come due; and
- maintain an optimal level of current assets such as cash (provides no return), accounts receivable, and inventory.

Working capital management encompasses all decisions involving a company's current assets and current liabilities. One very important aspect of working capital management is to provide enough cash to satisfy both maturing short-term obligations and operational expenditures—keeping the company sufficiently liquid.

In summary, working capital management helps a company run smoothly and mitigates the risk of illiquidity. Well-run companies make effective use of current liabilities to finance an optimal level of current assets and maintain sufficient cash balances to meet short-term operating goals and to satisfy short-term obligations. Working capital management is accomplished through

- cash management;
- credit and receivables management;
- inventory management; and
- accounts payable management.

## Components of Working Capital Management

In contrast to net working capital, gross working capital is synonymous with current assets, particularly those current assets that are either cash or cash equivalents or that will be converted to cash within a short period of time (i.e., in less than one year).

Below is a list of the components of gross working capital.

- Cash and cash equivalents
- Marketable securities
- Accounts receivable
- Inventory

Here is an example. On December 31, a company has the following balances and gross working capital:

| | |
|---|---|
| Cash and Equivalents | $ 100,000 |
| Marketable Securities | 250,000 |
| Accounts Receivable | 330,000 |
| Inventory | 425,000 |
| Gross Working Capital | $1,105,000 |

Think of the $1,105,000 of gross working capital as a source of funds for the most pressing obligations (i.e., current liabilities) of the company. Gross working capital is available to pay the bills. However, some of the current assets would need to be converted to cash first. Accounts receivable need to be collected, and inventory would need to be sold before it too can become cash. What if the company had $600,000 of current liabilities? That amount of current obligations could not be paid out of cash until the marketable securities were sold and a significant portion of accounts receivable were collected.

The second, more refined and useful concept of working capital is **net working capital**:

$$\text{NWC} = \text{Current Assets} - \text{Current Liabilities} \tag{19.2}$$

For example, if a company has $1,000,000 of current assets and $750,000 of current liabilities, its net working capital would be $250,000 ($1,000,000 less $750,000).

NWC provides a better picture because it takes into account the liability "coverage" provided by the current assets. As the above example shows, the current assets would "cover" the current liabilities with an excess of $250,000. Think of it this way: if the current assets could be converted to cash, they could be used to meet the current obligations with another $250,000 of cash leftover.

Current liabilities include

- accounts payable;
- dividends payable;
- notes payable (due within a year);
- current portion of deferred revenue;
- current maturities of long-term debt;
- interest payable;
- income taxes payable; and
- accrued expenses such as compensation owed to employees.

Net working capital possibilities can be thought of as a spectrum from negative working capital to positive, as

explained in Table 19.1.

| Negative Net Working Capital | Zero Net Working Capital | Positive Net Working Capital |
|---|---|---|
| Current liabilities are greater than current assets. | Current assets equal current liabilities. | Current assets are greater than current liabilities. |
| Could indicate a liquidity problem. There is difficulty satisfying current obligations. | Indicates that current assets could cover current obligations. However, there is no positive margin (safety cushion) or "liquid reserve" to satisfy unexpected cash needs. | Indicates that the company can meet its current obligations. However, excessively high net working capital could mean too little cash and therefore an opportunity cost (forgoing rates of return on alternative investment). |

**Table 19.1 Spectrum of Net Working Capital**

Measures of Financial Health provides information on a variety of financial ratios to help users of financial statements understand the strengths and weakness of companies' financial statements. Three of the financial ratios covered in that chapter are brought back into this chapter's discussion to demonstrate how financial managers examine working capital and liquidity. Liquidity is the ease with which an asset can be converted into cash. Those **ratios** are the current ratio, the quick ratio, and the cash ratio. A higher ratio indicates a greater level of liquidity.

The formulas for the three liquidity ratios are:

$$\begin{aligned} \text{Current Ratio} &= \frac{\text{Current Assets}}{\text{Current Liabilities}} \\ \text{Quick Ratio (Acid Test)} &= \frac{\text{Current Assets} - \text{Inventory}}{\text{Current Liabilities}} \\ \text{Cash Ratio} &= \frac{(\text{Cash} + \text{Marketable Securities})}{\text{Current Liabilities}} \end{aligned} \quad \textbf{19.3}$$

Notice how the current ratio includes the two elements of net working capital—current assets and current liabilities. It makes for a quick comparison of relative size or proportion.

THINK IT THROUGH

### Current Ratio

A company has $2,000,000 of current assets, while its current liabilities are $1,000,000. What is the current ratio, and what does it mean?

**Solution:**

The current ratio would be $2 = \$2{,}000{,}000/\$1{,}000{,}000$, which is a 2:1 proportion of current asset value to the amount of the current liabilities. This means that if all the current assets could be converted to cash, then the current liabilities could be satisfied two times.

There are two drawbacks to the current ratio: (1) it is a working capital analytic as of a point in time but is not indicative of future liquidity or future cash flows and (2) as an indicator of liquidity, it can be deceptive if a significant proportion of the current assets are inventory, supplies, or prepaid expenses. Inventory is not very liquid as it can take an extended time period to convert to cash, and assets such as supplies and prepaid expenses never become cash and therefore are not a source of funds to pay bills.

The quick ratio is considered a more conservative indication of liquidity since it does not include a firm's inventory: $(\text{Current Assets} - \text{Inventory})/\text{Current Liabilities}$.

THINK IT THROUGH

### Quick Ratio

A company's current assets total $2,000,000, but $500,000 of that is inventory and the current liabilities total $1,000,000. What is the quick ratio, and what does it mean?

**Solution:**

The quick ratio would be $1.5 = \$1{,}500{,}500/\$1{,}000{,}000$ and would indicate a smaller cushion of net working capital.

THINK IT THROUGH

### Cash Ratio

The cash ratio is even more conservative in that it presents a picture of liquidity by excluding all current assets except cash and marketable securities.

A company's total current assets are $2,000,000, but only $1,100,000 of the current assets consist of cash and marketable securities. Assuming $1,000,000 of current liabilities, what would be the cash ratio and what does it mean?

**Solution:**

The cash ratio would be $1.1 = \$1{,}100{,}000/\$1{,}000{,}000$, and the amount of cash is enough to pay the current bills by $100,000.

Working capital ratios, like any financial ratio, are most valuable when examined in light of trends and in comparison to industry/peer averages. For example, a deteriorating current ratio over several quarters (a decline in the company's current ratio) could indicate a reduced ability to pay bills.

Working capital ratios are also compared to industry averages, which are available in databases produced by such financial publishers as Dun & Bradstreet, Dow Jones Company, and the Risk Management Association (RMA). These information services are available via subscriptions and through many libraries. For example, if a company's current ratio is 0.9 while the industry average is 2.0, then the company is less liquid than the average company in its industry and strategies, and techniques need to be considered to change things and to better compete with peer groups. Industry averages can be aspirational, motivating management to set liquidity goals and best practices for working capital management.

It is common to think about working capital with a simple assumption: current assets are being "financed" by current liabilities. However, such an assumption may be an oversimplification. Some level of current assets is often necessary to meet longer-term obligations, and in that way, you could think of some amount of current assets as a permanent based of working capital that may need to be financed with longer-term sources of capital.

Think of a company with seasonal business. During busy times, more working capital will be needed than during certain other portions of the year, such as less busy times. But there will always be some level—a permanent base—of working capital needed. Think of it this way: the total working capital of many companies will ebb and flow depending on many variables such as the operating cycle, production needs, and the growth of revenue. Therefore, working capital can be thought of as having a permanent base that is always needed and a total working capital amount that increases when activity levels (i.e., production and sales volume) are

higher (see Figure 19.2).

## The Cash Cycle

The **cash cycle**, also called the **cash conversion cycle**, is the time period between when a business begins production and acquires resources from its suppliers (for example, acquisition of materials and other forms of inventory) and when it receives cash from its customers. This is offset by the time it takes to pay suppliers (called the payables deferral period).

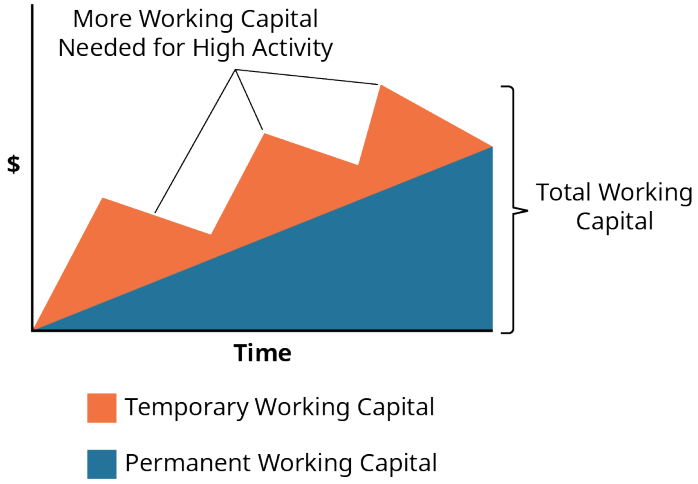



**Figure 19.2 Working Capital Needs Can Vary: Temporary and Permanent Working Capital**

The cash cycle is measured in days, and it is best understood by examining its formula:

$$\text{Cash Cycle} = \text{Inventory Conversion Period} + \text{Receivables Collection Period} - \text{Payables Deferral Period} \quad \textbf{19.4}$$

The inventory conversion period is also called the days of inventory. It is the time (days) it takes to convert inventory to sales and is calculated by following these steps:

1. First, calculate the Inventory Turnover Ratio using this formula:

$$\text{Inventory Turnover Ratio} = \frac{\text{Cost of Goods Sold}}{\text{Average Inventory}} \quad \textbf{19.5}$$

   The Average Inventory is arrived at as follows:

$$\text{Average Inventory} = \frac{(\text{Beginning Inventory} + \text{Ending Inventory})}{2} \quad \textbf{19.6}$$

2. Then, use the Inventory Turnover Ratio to calculate the Inventory Conversion Period:

$$\text{Inventory Conversion Period} = \frac{365}{\text{Inventory Turnover}} \quad \textbf{19.7}$$

The receivables collection period, also called the days sales outstanding (DSO) or the average collection period, is the number of days it typically takes to collect cash from a credit sale. It is calculated by following these steps:

1. First, calculate the Accounts Receivable Turnover using this formula:

$$\text{Accounts Receivable Turnover} = \frac{\text{Credit Sales}}{\text{Average Accounts Receivable}} \quad \textbf{19.8}$$

   The Average Accounts Receivable is arrived at as follows:

$$\text{Average Accounts Receivable} = \frac{(\text{Beginning Accounts Receivable} + \text{Ending Accounts Receivable})}{2} \quad \textbf{19.9}$$

2. Then, use the Accounts Receivable Turnover to calculate the Receivables Collection Period:

$$\text{Receivables Collection Period} = \frac{365}{\text{Accounts Receivable Turnover}} \quad \textbf{19.10}$$

The payables deferral period, also known as days in payables, is the average number of days its takes for a company to pay its suppliers. It is calculated by following these steps:

1. First, calculate the Accounts Payable Turnover using this formula:

$$\text{Accounts Payable Turnover} = \frac{\text{Cost of Goods Sold}}{\text{Average Accounts Payable}} \quad \textbf{19.11}$$

   The Average Accounts Payable is arrived at as follows:

$$\text{Average Accounts Payable} = \frac{(\text{Beginning Accounts Payable} + \text{Ending Accounts Payable})}{2} \quad \textbf{19.12}$$

2. Then, use the Accounts Payable Turnover to calculate the Payables Deferral Period:

$$\text{Payables Deferral Period} = \frac{365}{\text{Accounts Payable Turnover}} \quad \textbf{19.13}$$

## THINK IT THROUGH

### Periods of the Cash Cycle

Scenario 1: King Sized Products (KSP) Inc. has annual credit sales of $40,000,000. The average inventory is $3,000,000, and the company has average accounts receivable of $6,000,000 and average accounts payable of $2,800,000. The cost of goods sold for KSP Inc. is $30,000,000. The cash cycle for the company is 57.2 days. Calculate the inventory conversion, receivables collection, and payable deferral periods.

**Solution:**

Inventory conversion period:

- $\text{Inventory Turnover Ratio} = \frac{\$30{,}000{,}000}{\$3{,}000{,}000} = 10 \text{ times}$
- $\text{Inventory Conversion Period} = \frac{365}{10} = 36.5 \text{ days}$

Receivables collection period:

- $\text{Accounts Receivable Turnover} = \frac{\$40{,}000{,}000}{\$6{,}000{,}000} = 6.67 \text{ times}$
- $\text{Receivables Collection Period} = \frac{365}{6.67} = 54.7 \text{ days}$

Payables deferral period:

- $\text{Accounts Payable Turnover} = \frac{\$30{,}000{,}000}{\$2{,}800{,}000} = 10.71 \text{ times}$
- $\text{Payables Deferral Period} = \frac{365}{10.71} = 34 \text{ days}$

$$\text{Cash Conversion Cycle} = 36.5 \text{ days} + 54.7 \text{ days} - 34 \text{ days} = 57.2 \text{ days} \quad \textbf{19.14}$$

The solution (the entire cash conversion cycle) is also illustrated in a chart, Figure 19.3.

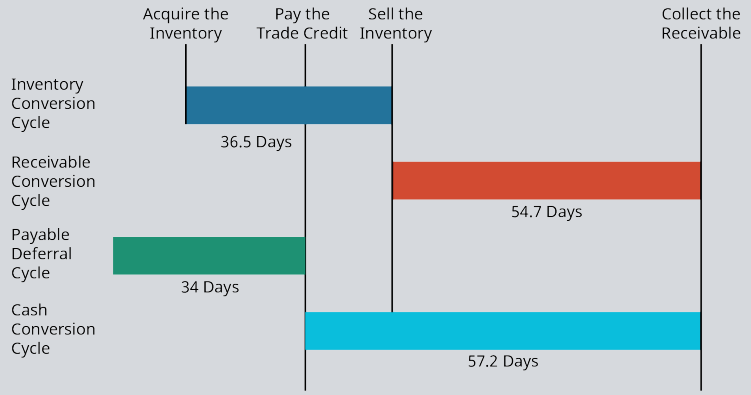



**Figure 19.3 Cash Conversion Cycle**

Shortening the inventory conversion period and the receivables collection period or lengthening the payables deferral period shortens the cash conversion cycle. Financial managers monitor and analyze each component of the cash conversion cycle. Ideally, a company's management should minimize the number of days it takes to convert inventory to cash while maximizing the amount of time it takes to pay suppliers.

Quickly converting inventory to sales speeds up cash inflows and shortens the cash cycle, but it also could help reduce inventory losses as a result of obsolescence. Inventory becomes obsolete because of a variety of factors including time—inventory that has not been sold for a long period of time and is not expected to be sold in the future has to be written down or written off according to accounting rules. Write-offs of inventory can result in significant losses for a company. In the food business, inventory conversion periods take on great importance because of spoilage of perishable goods; in retailing, seasonal items lose value the longer they stay on the shelves.

Various inventory management techniques are used to shorten production time in manufacturing, and in retailing, strategies are used to reduce the amount of time a product sits on the shelf or is stored in the warehouse. Production techniques such as **just-in-time inventory** systems and marketing and pricing strategies can have an impact on the number of days in the inventory conversion cycle.

For the receivables collection period, a relatively long receivables collection period means that the company is having trouble collecting cash from its customers and so whatever can be done to speed up collections while still offering competitive credit terms should be pursued by financial managers. For example, companies that converted paper invoicing to e-invoicing most likely reduce the average collection period by some number of days, as it makes sense that if a bill is transmitted electronically, lag time is cut (no delays because of "snail mail") and collections (payments back to the company from customers) may happen sooner. Other credit management techniques, some of which are explained in subsequent sections, can help minimize and control the receivables collection period.

The payables deferral period is the one element that probably cannot be optimized without violating credit terms. Certainly, cash balances can be conserved by delaying payments to vendors for as long as possible; however, payments on trade credit need to be made on time or the company's relationship with the supplier can suffer. In a worst-case scenario, the company's **credit rating** could also deteriorate.

A credit rating, also called a credit score, is a measure produced by an independent agency indicating the likelihood that a company will meet its financial obligations as they come due; it is an indication of the company's ability to pay its creditors. Three business credit rating services are Equifax Small Business, Experian Business, and Dun & Bradstreet.

## THINK IT THROUGH

### The Cash Conversion Cycle

Considering the previous Think It Through (Scenario 1), what if you could reduce inventory levels, hold lower accounts receivable balances, and rely more heavily on accounts payable while maintaining the same sales level?

Here's Scenario 2. Because of better inventory management, credit and collections management, and negotiation of longer payment periods with vendors, King Sized Products (KSP) Inc. needs less investment in inventory and accounts receivable and is able to utilize a greater amount of trade credit financing.

Annual credit sales are $40,000,000, average inventory is $2,800,000, average accounts receivable are $5,500,000, average accounts payable are $3,300,000, and cost of goods sold is $30,000,000. What is the cash conversion cycle?

**Solution:**

Inventory conversion period:

- $\text{Inventory Turnover Ratio} = \frac{\$30{,}000{,}000}{\$2{,}800{,}000} = 10.71 \text{ times}$
- $\text{Inventory Conversion Period} = \frac{365}{10.71} = 34.07 \text{ days}$
- $\text{Inventory Conversion Period} = \frac{365}{10.71} = 34.07 \text{ days}$

Receivables collection period:

- $\text{Accounts Receivable Turnover} = \frac{\$40{,}000{,}000}{\$5{,}500{,}000} = 7.27 \text{ times}$
- $\text{Receivables Collection Period} = \frac{365}{7.27} = 50.21 \text{ days}$

Payables deferral period:

- $\text{Accounts Payable Turnover} = \frac{\$30{,}000{,}000}{\$3{,}300{,}000} = 9.09 \text{ times}$
- $\text{Payables Deferral Period} = \frac{365}{9.09} = 40.15 \text{ days}$

$$\text{Cash Conversion Cycle} = 34.07 \text{ days} + 50.21 \text{ days} - 40.15 \text{ days} = 44.13 \text{ days} \quad \textbf{19.15}$$

Notice that the investment in inventory and accounts receivable is less and the average accounts payable is more with no change in credit sales and cost of goods sold—you would certainly anticipate a reduction in the cash conversion cycle. The improvement would be about 13 days (from 57.2 in Scenario 1 to 44.1 days in Scenario 2). Figure 19.4 shows a bar chart comparison of the two scenarios.

| | Scenario 1 | Scenario 2 |
|---|---|---|
| Inventory Conversion Period | 36.50 | 34.07 |
| Receivables Collection Period | 54.75 | 50.21 |
| Payables Deferral Period | 34.07 | 40.15 |
| Cash Conversion Cycle | 57.18 | 44.10 |

**Table 19.2**

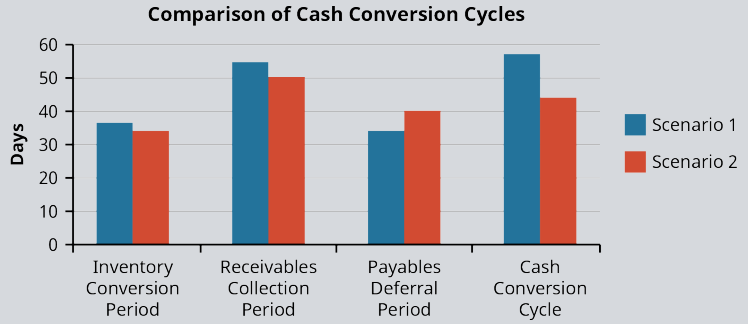



**Figure 19.4 Scenario 1 and 2 Comparison: Shortening the Cash Conversion Cycle**

## LINK TO LEARNING

A Harvard Business School blog post, How Amazon Survived the Dot-Com Bubble (https://openstax.org/r/how-amazon-survived), discusses how Amazon managed its cash conversion cycle to the point where it was receiving payment for the things it sold before Amazon had to pay for them. In that way, Amazon had a negative cash conversion cycle (which is really a huge positive for a company trying to manage positive cash flow!).

## Working Capital Needs by Industry

When comparing working capital needs by industry, you can see some variation. For example, some companies in the grocery business can have very low cash conversion cycles, while construction companies can have very high cash conversion cycles. And some companies, like those in the restaurant business, can have very low numbers and even have negative cash conversion cycles.

Working capital can also differ from one industry to another. An often cited general rule is that a current ratio of 2 is considered optimal. However, general rules of thumb must be treated with caution. A better **benchmarking** approach is to compare a firm's ratios—current ratio and quick ratios—to the average of the industry in which the subject company operates.

Take, for example, a home construction company. Such as firm has a long **operating cycle** because of the production process (building homes), and the "storage of finished goods" can result in very high current ratios—such as 11 or 12 times current liabilities—whereas a retailer like Walmart or Target would have much lower current ratios.

In recent years, Walmart Stores Inc. (NYSE: WMT) has had a current ratio of around 0.9 and has been able to manage its working capital needs by efficient management of its supply chain, quick turnover of inventory, and a very small investment in accounts receivables.[1] Big retailers like Walmart are effective at negotiating favorable payment terms with their vendors. The ability to generate consistent positive cash flow from operations allows a retailer like Walmart to operate with relatively low amounts of working capital.

The credit policies of a company also affect working capital. A company with a liberal credit policy will require a greater amount of working capital, as collection periods of accounts receivable are longer and therefore tie up more dollars in receivables.

Almost all businesses will have times when additional working capital is needed to pay bills, meet the payroll (salaries and wages), and plan for accrued expenses. The wait for the cash to flow into the company's treasury

1 Walmart Inc. "2020 Annual Report." 2020. https://corporate.walmart.com/media-library/document/2020-walmart-annual-report/_proxyDocument?id=00000171-a3ea-dfc0-af71-b3fea8490000

from the collection of receivables and cash sales can be longer during tough times.

During the COVID-19 pandemic, the US government made paycheck protection program (PPP) loans available to help alleviate working capital problems for small and large business when the economy slowed because of shutdowns and social distancing. And although 60 percent of the PPP loan proceeds were to go to cover payroll-related costs, 40 percent could be used to bolster working capital to meet rent, utilities costs, and some interest expense while companies were "treading water"—waiting for positive cash flow to pick up under a recovery.[2]

It isn't just during downturns that working capital is strained. Growing companies, even if they are extremely profitable, need additional working capital as they ramp up operations by acquiring raw materials, component parts, supplies, or other forms of inventory; hiring temporary or additional employees; and taking on new projects. Whenever additional resources are needed, working capital is also needed.

Some of the current assets and expenditures needed in a growing company may need to be financed from sources that are not spontaneous financing—**trade credit** (accounts payable). Such forms of external financing such as lines of credit, short-term bank loans, inventory-based loans (also called **floor planning**), and the **factoring** of accounts receivables might have to be relied upon.

## 19.2 What Is Trade Credit?

By the end of this section, you will be able to:

- Compute the cost of trade credit.
- Define cash discount.
- Define discount period.
- Define credit period.

Trade credit, also known as *accounts payable*, is a critical part of a business's working capital management strategy. Trade credit is granted by vendors to creditworthy companies when those companies purchase materials, inventory, and services.

A company's purchasing system is usually integrated with other functions such production planning and sales forecasting. Purchasing managers search for and evaluate vendors, negotiate order quantities, and prepare purchase orders. In carrying out the purchasing process, credit terms are granted by the company's vendors and purchases of inventory and services can be made on trade credit accounts—allowing the purchaser time to pay. The purchaser carries an accounts payable balance until the account is paid.

Trade credit is referred to as spontaneous financing, as it occurs spontaneously with the gearing up of operations and the additional investment in current assets. Think of it this way: If sales are increasing, so too is production. Increased sales mean more current assets (accounts receivable and inventory), and increased sales mean increases in accounts payable (financing happening spontaneously with increased sales and inventory purchases). Compared to other financing arrangements, such as lines of credit and bank loans, trade credit is convenient, simple, and easy to use.

Once a company is approved for trade credit, there is no paperwork or contracts to sign, as is the case with various forms of bank financing. Invoices specify the credit terms, and there is usually no interest expense associated with trade credit. Accounts payable is a type of obligation that is interest-free and is distinguished from debt obligations, such as notes payable, that require the creditor to pay back principal and interest.

### How Trade Credit Works

Trade credit is common in B2B (business to business) transactions and is analogous to consumer spending using a credit card. With a credit card, a consumer opens an account with a credit limit. Most trade credit is

2 US Small Business Administration. "PPP Loan Forgiveness." n.d. https://www.sba.gov/funding-programs/loans/covid-19-relief-options/paycheck-protection-program/ppp-loan-forgiveness

offered to a company with an open account that has a credit limit up to which the company can purchase goods or services without having to pay the cash up front. As long as the payments are made in accordance with the terms of the agreement (also called credit terms), no interest or additional fees are charged on the credit balance except possibly for a fee for late payment.

Initially, the vendor's credit department approves both a trade credit limit and credit payment terms (i.e., number of days after the invoice date that payment is due). Timely payments on accounts payable (trade credit) helps create a credit history for the purchasing firm.

## Trade Credit Terms

Trade credit arrangements often carry credit terms that offer an incentive, called a discount, for a company (the buyer) to pay its bill within a relatively short period of time. **Net terms**, also referred to as the full **credit period**, are the number of days that a business (purchaser) has before they must pay their invoice. A common net term is Net 30, with payment due in full within 30 days of the invoice.

Many vendors also offer **cash discounts** to customers that pay their bill early. A company's invoice that specifies payment terms of "2/10 n/30" (stated as: "two ten net 30") would allow a 2 percent discount if the buyer's account balance is paid within 10 days of the invoice date; otherwise, the net amount owed would be due in 30 days. The "10 days" in the example is the **discount period**—the number of days the buyer has to take advantage of the cash discount for an early payment, also known as **quick payment**.

For example, Jackson's Premium Jams Inc. received a $10,500 invoice for the purchase of jelly jars. The invoice has payment terms of 2/10 n/30. Jackson's pays the bill within 10 days of the invoice date. Jackson's payment would be $\$10{,}290 = (\$10{,}500 \times (100\% - 2\%))$. The effect of taking a discount because of a quick payment is a lowering of the cost of inventory in the case of purchases of materials (for a manufacturer), merchandise (for a retailer or wholesaler), and operating expenses (for any company that "buys" services using trade credit). In Cost of Trade Credit, there is an example that shows the high annualize opportunity cost (36.73 percent) of not taking advantage of cash discounts.

### CONCEPTS IN PRACTICE

#### Trade Credit of International Trade

When international trade occurs, two important documents are commonly required: a **letter of credit** and a **bill of lading**. A letter of credit is issued by a financial institution on behalf of the foreign buyer (importer). The bill of lading is a legal document that gives proof of a contract between a transportation company and the buyer and is one important piece of documentation that allows the buyer to draw on the letter of credit. A bill of lading serves as a document of title and proof of receipt of goods by the shipper.

The letter of credit secures a promise of payment to the seller (exporter) provided that the terms of the sale are met. For an international trade transaction, the letter of credit is the main mechanism that establishes a liability for the buyer. Instead of a trade payable, the buyer uses a line of credit from a bank.

## Cost of Trade Credit

Trade credit is often referred to as a no-cost type of financing. Unlike with other credit arrangements (e.g., bank loans, lines of credit, and commercial paper), there is usually no interest expense associated with trade credit, and as long as your account does not become delinquent, there are no special fees. Some accounts payable arrangements specify an interest penalty or a late fee when the account goes delinquent, but as long as payments are made on time, trade credit is thought of as a low-cost source of working capital.

However, there is one possible cost associated with trade credit for companies that don't take advantage of cash discounts when offered by sellers. Using accounts payable to purchase goods and services can involve an

**opportunity cost**—a cost of the forgone opportunity of making a quick payment and benefiting from a cash discount. A business that does not take advantage of a cash discount for early payment of trade credit will pay more for goods and services than a business that routinely takes advantage of discounts.

The annual percentage rate of forgoing quick payment discounts can be estimated with the following formula:

$$\text{APR of Forgoing Quick Payment Discounts} = \frac{360}{\text{Full Credit Period} - \text{Discount Period}} \times \frac{\text{Discount}}{100 - \text{Discount \%}} \quad \textbf{19.16}$$

Example: Novelty Accessories Inc. (NAI) purchases products from a vendor that offers credit payment terms of 2/10, net 30. The annual cost to NAI of not taking advantage of the discount for quick payment is 36.73 percent.

$$\text{APR of Quick Payment Discounts} = \frac{360}{30 - 10} \times \frac{2\%}{100\% - 2\%} = \frac{360}{20} \times \frac{2\%}{98\%} = 36.73\% \quad \textbf{19.17}$$

# 19.3 Cash Management

By the end of this section, you will be able to:

- Explain why firms hold cash.
- List instruments available to a financial manager for investing cash balances.

Cash management means efficiently collecting cash from customers and managing cash outflows. To manage cash, the **cash budget**—a forward-looking document—is an important planning tool. To understand cash management, you must first understand what is meant by cash holdings and the motivations (reasons) for holding cash. A cash budget example is covered in Using Excel to Create the Short-Term Plan.

## Cash Holdings

The cash holdings of a company are more than the currency and coins in the cash registers or the treasury vault. Cash includes currency and coins, but usually those amounts are insignificant compared to the cash holdings of checks to be deposited in the company's bank account and the balances in the company's checking accounts.

### Motivations for Holding Cash

The initial answer to the question of why companies hold cash is pretty obvious: because cash is how we pay the bills—it is the medium of exchange. The **transactional motive** of holding cash means that checks and electronic funds transfers are necessary to meet the payroll (pay the employees), pay the vendors, satisfy creditors (principal and interest payments on loans), and reward stockholders with dividend payments. Cash for transaction is one reason to hold cash, but there is another reason—one that stems from uncertainty and the precautions you might take to be ready for the unexpected.

Just as you keep cash balances in your checking and savings accounts and even a few dollars in your wallet or purse for unexpected expenditures, cash balances are also necessary for a business to provide for unexpected events. Emergencies might require a company to write a check for repairs, for an unexpected breakdown of equipment, or for hiring temporary workers. This motive of holding cash is called the **precautionary motive**.

Some companies maintain a certain amount of cash instead of investing it in marketable securities or in upgrades or expansion of operations. This is called the **speculative motive**. Companies that want to quickly take advantage of unexpected opportunities want to be quick to purchase assets or to acquire a business, and a certain amount of cash or quick access to cash is necessary to jump on an opportunity.

Sometimes cash balances may be required by a bank with which a company conducts significant business. These balances are called **compensating balances** and are typically a minimum amount to be maintained in the company's checking account.

For example, Jack's Outback Restaurant Group borrowed $500,000 from First National Bank and Trust. As part of the loan agreement, First National Bank required Jack's to keep at least $50,000 in its company checking account as a way of compensating the bank for other corporate services it provides to Jack's Outback Restaurant Group.

## Cash Alternatives

Cash that a company has that is in excess of projected financial needs is often invested in short-term investments, also known as cash equivalents (cash alternatives). The reason for this is that cash does not earn a rate of return; therefore, too much idle cash can affect the profitability of a business.

Table 19.3 shows a list of typical investment vehicles used by corporations to earn interest on excess cash. Financial managers search for opportunities that are safe and highly liquid and that will provide a positive rate of return. Cash alternatives, because of their short-term maturities, have low interest rate risk (the risk that an investment's value will decrease because of changes in market interest rates). In that way, prudent investment of excess cash follows the risk/return trade-off; in order to achieve safe returns, the returns will be lower than the possible returns achieved with risky investments. Cash alternative investments are not committed to the stock market.

| Security | Description |
|---|---|
| US Treasury bills | Obligations of the US government with maturities of 3 and 6 months |
| Federal agency securities | Obligations of federal government agencies such as the Federal Home Loan Bank and the Federal National Mortgage Association |
| Certificates of deposit | Issued by banks, a type of savings deposit that pays interest |
| Commercial paper | Short-term promissory notes issued by large corporations with maturities ranging from a few days to a maximum of 270 days |

**Table 19.3 Typical Cash Equivalents**

Figure 19.5 shows a note within the 2021 Annual Report (Form 10-K) of Target Corporation. The note discloses the amount of Target's cash and cash equivalent balances of $8,511,000,000 for January 30, 2021, and $2,577,000,000 for February 1, 2020.

**8. Cash and Cash Equivalents**

Cash equivalents include highly liquid investments with an original maturity of three months or less from the time of purchase. Cash equivalents also include amounts due from third-party financial institutions for credit and debit card transactions. These receivables typically settle in five days or less.

| **Cash and Cash Equivalents** (millions) | January 30, 2021 | February 1, 2020 |
|---|---|---|
| Cash | $ 307 | $ 326 |
| Short-term investments | 7,644 | 1,810 |
| Receivables from third-party financial institutions for credit and debit card transactions | 560 | 441 |
| Cash and cash equivalents *(a)* | $8,511 | $2,577 |

(*a*) We have access to these funds without any significant restrictions, taxes or penalties.

**Figure 19.5 Note from Target Corporation 2021 10-K Filing** (source: US Securities and Exchange Commission/EDGAR)

In that note, which is a supplement to the company's balance sheet, receivables from third-party financial institutions is also considered a cash equivalent. That is because purchases by Target's customers who use their credit cards (e.g., VISA or MasterCard) create very short-term receivables—amounts that Target is waiting to collect but are very close to a cash sale. So instead of being reported as accounts receivable—a line item on the Target balance sheet that is separate from cash and cash equivalents—these amounts receivable from third-party financial institutions are considered part of the cash and cash equivalents and are a very liquid asst. For example, the amount of $560,000,000 for January 30, 2021, is considered a cash equivalent since the settlement of these accounts will happen in a day or two with cash deposited in Target's bank accounts. When a retailer sells product and accepts a credit card such as VISA, MasterCard, or American Express, the cash collection happens very soon after the credit card sale—typically within 24 to 72 hours.[3]

Companies also invest excess funds in marketable securities. These are debt and equity investments such as corporate and government bonds, preferred stock, and common stock of other entities that can be readily sold on a stock or bond exchange. Ford Motor Company has this definition of marketable securities in its 2019 Annual Report (Form 10-K):

"Investments in securities with a maturity date greater than three months at the date of purchase and other securities for which there is more than an insignificant risk of change in value due to interest rate, quoted price, or penalty on withdrawal are classified as *Marketable securities*."[4]

## 19.4 Receivables Management

By the end of this section, you will be able to:

- Discuss how decisions on extending credit are made.
- Explain how to monitor accounts receivables.

For any business that sells goods or services on credit, effective accounts receivable management is critical for cash flow and profitability planning and for the long-term viability of the company. Receivables management begins before the sale is made when a number of factors must be considered.

- Can the customer be approved for a credit sale?
- If the credit is approved, what will be the credit terms (i.e., how long do we give customers to pay their bills)?
- Will there be a cash discount for quick payment?
- How much credit should be extended to each customer (credit limit)?

Accounts receivable is not about accepting credit cards. Credit card sales are not technically accounts receivable. When a credit card is accepted, it means that the credit card company (e.g., VISA, MasterCard, or American Express) will guarantee the payment. The cash will be deposited in the merchant's bank account in a very short period of time.

When a business makes a sale on account, management (e.g., a credit manager or analyst) does its best to distinguish between customers who have a high likelihood of paying and customers who have a low likelihood. Customers with low credit risk are approved; the decision is based on an effective analysis of creditworthiness.

Creditworthiness is judged by looking at a number of factors including an evaluation of the customer's financial statements, financial ratios, and credit reports (credit scores) based on a customer's payment history on credits owed to other firms. If a company has a prior relationship with a customer seeking trade credit, the customer's payment history with the firm is also carefully evaluated before additional credit is granted.

3 Creditcardprocessing.com. "How Long Does it Take for a Merchant to Receive Funds?" n.d. https://www.creditcardprocessing.com/resource/article/long-take-merchant-receive-funds/#:~:text=The%20time%20that%20it%20takes,days%20to%20process%20the%20payment

4 Ford Motor Company. "2019 Annual Report." n.d. https://s23.q4cdn.com/725981074/files/doc_downloads/Ford-2019-Printed-Annual-Report.pdf

LINK TO LEARNING

Corporate Finance Institute

Credit managers use various tools and techniques to evaluate creditworthiness of customers. The Corporate Finance Institute's website states that "the '5 Cs of Credit' is a common phrase used to describe the five major factors [character, capacity, collateral, capital, and conditions] used to determine a potential borrower's creditworthiness." It goes on to say that "a credit report provides a comprehensive account of the borrower's total debt, current balances, credit limits, and history of defaults and **bankruptcies**, if any."[5] More on the 5 Cs of credit can be found on the Corporate Finance Institute's website (https://openstax.org/r/corporate-finance).

## Determining the Credit Policy

A company's credit policy encompasses rules of credit granting and procedures for the collections of accounts. It's how a company will process credit applications, utilize credit scoring and credit bureaus, analyze financial statements, make credit limit decisions, and conduct collection efforts when accounts become *delinquent* (still outstanding after their due date).

## Establishing Credit Terms

Trade credit terms were discussed earlier. Recall that part of the terms and conditions of a sale are the **credit terms**—elements of a sales agreement (contract) that indicate when payment is due, possible discounts (for quick payments), and any late fee charges.

If open credit is for a sales transaction, an agreement is made as to the length of time for which credit is to be granted (payment period) and a discount for early payment. Although companies are free to establish credit terms as they see fit, most companies look to the practice of the particular industry in which they operate. The credit terms offered by the competition are a factor. Net terms usually range between 30 days and 90 days, depending on the industry. Discounts for early payments also differ and are typically from 1 to 3 percent.

Establishing credit terms offered can be thought of as a decision process similar to setting a price for products and services. Just as a price is the result of a market forces, so too are credit terms. If credit terms are not competitive within the industry, sales can suffer. Typically, companies follow standard industry credit terms. If most companies in an industry offer a discount for early payments, then most companies will follow suit and also offer an equal discount.

Once credit terms are established, they can be changed based on both marketing strategies and financial management goals. For example, discounts for early payments can be more generous, or the full **credit period** can be extended to stimulate additional sales. Both discount periods and full credit periods can be tightened to try to speed up collections. The establishment of and changes to credit terms are usually made in consultation with the sales and financial management departments.

## Monitoring Accounts Receivables

Financial managers monitor accounts receivables using some basic tools. One of those tools is the **accounts receivable aging schedule** (report). To prepare the aging schedule, a classifying of customer account balances is performed with age as the sorting attribute.

An account receivable begins its life as a credit sale. The age of a receivable is the number of days that have transpired since the credit sale was made (the date of the invoice). For example, if a credit sale was made on June 1 and is still unpaid on July 15, that receivable is 45 days old. Aging of accounts is thought to be a useful

5 Corporate Finance Institute. "What Are the 5 Cs of Credit?" n.d. https://corporatefinanceinstitute.com/resources/knowledge/credit/5-cs-of-credit/

tool because of the idea that the longer the time owed, the greater the possibility that individual accounts receivable will prove to be uncollectible.

An aging schedule is a report that organizes the outstanding (unpaid) receivable balances into age categories. The receivables are grouped by the length of time they have been outstanding, and an uncollectible percentage is assigned to each category. The length of uncollectible time increases the percentage assigned. For example, a category might consist of accounts receivable that are 0–30 days past due and is assigned an uncollectible percentage of 6 percent. Another category might be 31–60 days past due and is assigned an uncollectible percentage of 15 percent. All categories of estimated uncollectible amounts are summed to get a total estimated uncollectible balance.

The aging of accounts is useful to the credit and collection managers, both from a global view—estimating how much of the accounts receivable asset might be bad debts—and on a micro basis—being able to drill down to see which specific customers are slow paying or delinquent so as to implement collection tactics.

Accountants and auditors also find the aging of accounts to determine a reasonable amount to be reported as **bad debt expense** and to establish a sufficient balance in the **allowance for doubtful accounts**. Bad debt expense is the cost of doing business because some customers will not pay the amounts they owe (accounts receivable), while the allowance for doubtful accounts is a **contra-asset** (it will be deducted from accounts receivable on the balance sheet) that contains management's best guess (management's estimate) as to how much of its accounts receivable will never be collected.

In Figure 19.6, Foodinia Inc.'s accounts receivable aging report shows that the total receivables balance is $189,000. The company splits its accounts into four age categories: not due, 30 to 60 days past due, 61 to 90 days past due, and more than 90 days past due. Of the $189,000 owed to Foodinia by its customers, $75,500 ($189,000 less $113,500) of invoices have been outstanding (not paid yet) beyond their due dates.

| Customer Name | Not Due | 30 to 60 Days Past Due | 61 to 90 Days Past Due | More than 90 Days Past Due | Total Receivables |
|---|---|---|---|---|---|
| Arithmio | $ 15,000 | | | | $ 15,000 |
| Bakely Inc. | | $16,000 | $ 5,000 | $4,000 | 25,000 |
| Bakeville | 30,000 | | | | 30,000 |
| Boxfully | | 27,000 | | | 27,000 |
| City Shop | 5,000 | | | | 5,000 |
| Deskmeter | | 5,000 | | | 5,000 |
| Flavorica | 6,000 | | | | 6,000 |
| Merchain | 7,000 | | | | 7,000 |
| Mshops | 8,500 | | | | 8,500 |
| Next Dessert | | | 12,000 | | 12,000 |
| Pichets | | | | 5,000 | 5,000 |
| Shopahoo | 19,000 | | | | 19,000 |
| SportsBuzz Ltd | 2,000 | 1,500 | | | 3,500 |
| Wearsy USA | 21,000 | | | | 21,000 |
| **Totals** | **$113,500** | **$49,500** | **$17,000** | **$9,000** | **$189,000** |

**Figure 19.6 Foodinia Inc. Aging of Accounts Receivable Schedule**

In addition to preparing aging schedules, financial managers also use financial ratios to monitor receivables. The accounts receivable turnover ratio determines how many times (i.e., how often) accounts receivable are collected during an operating period and converted to cash. A higher number of times indicates that receivables are collected quickly. In contrast, a lower accounts receivable turnover indicates that receivables are collected at a slower rate, taking more days to collect from a customer.

Another receivables ratio is the number of days' sales in receivables ratio, also called the receivables collection period—the expected days it will take to convert accounts receivable into cash. A comparison of a company's receivables collection period to the credit terms granted to customers can alert management to collection problems. Both the accounts receivable turnover ratio and receivables collection period are covered, including the formulas for calculating the ratios, in the previous section of this chapter.

## Accounts Receivables and Notes Receivable

An accounts receivable is an informal arrangement between a seller (a company) and customer. Accounts receivable are usually paid within a month or two. Accounts receivable don't require any complex paperwork, are evidenced by an invoice, and do not involve interest payments. In contrast, a note receivable is a more formal arrangement that is evidence by a legal contract called a promissory note specifying the payment amount and date and interest.

The length of a note receivable can be for any time period including a term longer than the typical account receivable. Some notes receivable have a term greater than a year. The assets of a bank include many notes receivable (a loan made by a bank is an asset for the bank).

A note receivable can be used in exchange for products and services or in exchange for cash (usually in the case of a financial lender). Sometimes a company might request that a slow-paying customer sign a note promissory note to further secure the receivable, charge interest, or add some type of collateral to the arrangement, in which case the receivable would be called a secured promissory note. Several characteristics of notes receivable further define the contract elements and scope of use (see Table 19.4).

| Accounts Receivable | Notes Receivable |
|---|---|
| • An informal agreement between customer and company<br>• Receivable in less than one year or within a company's operating cycle<br>• Does not include interest | • A legal contract with established payment terms<br>• Receivable beyond one year and outside of a company's operating cycle<br>• Includes interest<br>• Could stipulate collateral |

**Table 19.4 Key Feature Comparison of Accounts Receivable and Notes Receivable**

# 19.5 Inventory Management

By the end of this section, you will be able to:
- Outline the costs of holding inventory.
- Outline the benefits of holding inventory.

Financial managers must consider the impact of inventory management on working capital. Earlier in the chapter, the concept of the inventory conversion cycle was covered. The number of days that goods are held by a business is one of the focal points of inventory management.

Managers look to minimize inventory balances and raise inventory turnover ratios while trying to balance the needs of operations and sales. Purchasing personnel need to order enough inventory to "feed" production or to stock the shelves. The sales force wants to meet or surpass their sales budgets, and the operations people need inventory for the factories, warehouses, and e-commerce sites.

The days in inventory ratio measures the average number of days between acquiring inventory (i.e., purchasing merchandise) and its sale. This ratio is a metric to be watched and monitored by inventory managers and, if possible, minimized. A high days in inventory ratio could mean "aging" inventory. Old inventory could mean obsolesce or, in the case of perishable goods, spoilage. In either case, old inventory means losses.

Imagine a company selling high-tech products such as consumer electronics. A high days in inventory ratio could mean that technologically obsolete products will be sold at a discount. There are similar issues with older inventory in the fashion industry. Last year's styles are not as appealing to the fashion-conscious consumer and are usually sold at significant discounts. In the accounting world, *lower of cost or market value* is a test of inventory value to determine if inventory needs to be "written down," meaning that the company

takes an expense for inventory that has lost significant value. Lower of cost or market is required by Generally Accepted Accounting Principles (GAAP) to state inventory valuations at realistic and conservative values.

Inventory is a very significant working capital component for many companies, such as manufacturers, wholesalers, and retailers. For those companies, inventory management involves management of the entire **supply chain**: sourcing, storing, and selling inventory. At its very basic level, inventory management means having the right amount of stock at the right place and at the right time while also minimizing the cost of inventory. This concept is explained in the next section.

### Inventory Cost

Controlling inventory costs minimizes working capital needs and, ultimately, the cost of goods sold. Inventory management impacts profitability; minimizing cost of goods sold means maximizing gross profit (Gross Profit = Net Sales Less Cost of Goods Sold).

There are four components to inventory cost:

- Purchasing costs: the invoice amount (after discounts) for inventory; the initial investment in inventory
- **Carrying costs**: all costs of having inventory in stock, which includes storage costs (i.e., the cost of the space to store the inventory, such as a warehouse), insurance, inventory obsolescence and spoilage, and even the opportunity cost of the investment in inventory
- **Ordering costs**: the costs of placing an order with a vendor; the cost of a purchase and managing the payment process
- **Stockout costs**: an opportunity cost incurred when a customer order cannot be filled and the customer goes elsewhere for the product; lost revenue

Minimizing total inventory costs is a combination of many strategies, the scope and complexity of which are beyond the scope of this text. Concepts such as *just-in-time (JIT)* inventory practices and *economic order quantity (EOQ)* are tools used by inventory managers, both of which help keep a company lean (minimizing inventory) while making sure the inventory resources are in place in time to complete the sale.

### Benefit of Holding Inventory

Brick-and-mortar stores need goods in stock so that the customer can see and touch the product and be able to acquire it when they need it. Customers are disappointed if they cannot see and touch the item or if they find out upon arrival at the store that it is out of stock.

Customers of all kinds don't want to wait for the delivery of a purchase. We have become accustomed to Amazon orders being delivered to the door the next day. Product fulfillment and availability is important. Inventory must be in stock, or sales will be lost.

In manufacturing, the inventory of materials and component parts must be in place at the start of the value chain (the conversion process), and finished goods need to be ready to meet scheduled shipments. Holding sufficient inventory meets customer demand, whether it is products on the shelves or in the warehouse that are ready to move through the supply chain and into the hands of the customer.

## 19.6 Using Excel to Create the Short-Term Plan

By the end of this section, you will be able to:

- Create a one-year budget.
- Create a cash budget.

A cash budget is a tool of cash management and therefore assists financial managers in the planning and control of a critical asset. The cash budget, like any other budget, looks to the future. It projects the cash flows into and out of the company. The budgeting process of a company is a really an integrated process—it links a

series of budgets together so that company objectives can be achieved. For example, in a manufacturing company, a series of budgets such as those for sales, production, purchases, materials, overhead, selling and administrative costs, and planned capital expenditures would need to be prepared before cash needs (cash budget) can be predicted.

Just as you might budget your earnings (salary, business income, investment income, etc.) to see if you will be able to cover your expected living expenses and planned savings amounts, to be successful and to increase the odds that sufficient cash will be available in the months ahead, financial managers prepare cash budgets to

- meet payrolls;
- allocate dollars for contingencies and emergencies;
- analyze if planned collections and disbursements policies and procedures result in adequate cash balances; and
- plan for borrowings on lines of credit and short-term loans that might be needed to balance the cash budget.

A cash budget is a model that often goes through several iterations before managers can approve it as the plan going forward. Changes in any of the "upstream" budgets—budgets that are prepared before the cash budget, such as the sales, purchases, and production budgets—may need to be revised because of changing assumptions. New economic forecasts and even cost-cutting measures will require a revision of the cash budget.

Although a budget might be prepared for each month of a future 12-month period, such as the upcoming fiscal year, a rolling budget is often used. A rolling budget changes often as the planning period (e.g., a fiscal year) plays out. When one month ends, another month is added to the end (the next column) of the budget. For example, if in your budget January is the first month of the planning period, once January is over, next January's cash budget column would be added—right after December's column (at the far right of the budget).

## Sample One-Year (Annual) Operating Budget

Preparing an annual operating budget can be a complex task. In essence, a company budget is a series of budgets, many of which are interrelated.

The sales budget is prepared first and has an impact on many other budgets. Take the example of a production budget of a manufacturer. The sales budget impacts what needs to be produced (production budget), and the production budget influences planned purchases of material (purchases budget), overhead resources (overhead budget), and the amount of labor costs for the year ahead (direct labor budget.)

For a merchant (such as a wholesaler or retailer), the annual budget would be less complex than that of a manufacturing firm but would still require an inventory purchases budget and an operating expense budget (such as selling and administrative expenses). For a service firm, a purchase budget for inventory would not be necessary, but an operating budget would be. All businesses need a cash budget, which is the topic of the next section of this chapter.

The example operating budget presented here is of a merchandising company. Budgets are prepared following a process that begins with a sales (or revenue) forecast. The sales forecast is normally based on information obtained from both internal and external sources and predicts the amount of units to be sold in the planning period—usually one year into the future.

A company's management, in consultation with its marketing and sales executives, would prepare a sales budget by making assumptions about the number of units that are expected to be sold and the prices that will be charged. From the sales budget, projections are made as to cash receipts each month, and therefore assumptions have to be made as to how much of each month's sales will be cash sales and how much cash will flow into the company from the collection credit sales (including cash flow in from the prior month's sales).

Figure 19.7 provides an example of a sales budget and projected accounts receivable collections and cash sales for the months of January through December. Keep in mind that projected monthly sales amounts are not equal to cash collected from sales. Because of sales on credit, some cash from sales lags credit sales as collections can extend beyond the month of sale. Credit terms such terms such as net 30 (net amount owed to be paid in 30 days) have to be considered when developing a forecasted cash collection pattern.

| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| 10 | | **January** | **February** | **March** | **April** | **May** | **June** |
| 11 | **Total Sales** | $ 460,000 | $ 500,000 | $ 600,000 | $ 540,000 | $ 486,000 | $ 534,600 |
| 12 | Accounts Receivable Collections/Cash Sales | 400,000 | 460,300 | 513,000 | 568,000 | 518,700 | 491,130 |
| 13 | | | | | | | |
| 14 | | **July** | **August** | **September** | **October** | **November** | **December** |
| 15 | **Total Sales** | 580,000 | 667,000 | 653,000 | 640,000 | 576,000 | 460,000 |
| 16 | Accounts Receivable Collections/Cash Sales | $ 532,828 | $ 587,880 | $ 645,810 | $ 637,390 | $ 611,850 | $ 538,680 |

**Figure 19.7 Example of a Sales and Collections Budget**

*Download the spreadsheet file (https://openstax.org/r/spreadsheet-file1) containing key Chapter 19 Excel exhibits.*

Sales budgets "drive" the preparation of other budgets. If sales are expected to increase, purchases of inventory and some operating expenses would also increase. To meet the demand for goods and services (as defined in the sales budget), a purchases (inventory) budget would be prepared. In this example (Figure 19.8), the purchases budget shows projected purchases of inventory (merchandise) and the projected payments (also called disbursements) for each month.

Cash outflows as a result of purchases often do not equal the projected purchase amount. That is because payments for purchases are usually on credit (accounts payable), and so purchases for one month typically get spread out over a period of time that encompasses the current month and the month (or months) thereafter. To keep this example simple, the assumption is that the purchases are paid for in the following month (an average days payable outstanding of 30 days). However, in other cases, payment patterns may be based on other payment periods such as 45, 60, or even 90 days, depending on the trade credit terms.

| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| 1 | | **January** | **February** | **March** | **April** | **May** | **June** |
| 2 | **Purchases** | $ 225,000 | $ 270,000 | $ 243,000 | $ 219,000 | $ 241,000 | $ 260,000 |
| 3 | Payments | 190,000 | 225,000 | 270,000 | 243,000 | 219,000 | 241,000 |
| 4 | | | | | | | |
| 5 | | **July** | **August** | **September** | **October** | **November** | **December** |
| 6 | **Purchases** | 300,000 | 293,000 | 288,000 | 259,000 | 207,000 | 200,000 |
| 7 | Payments | $ 260,000 | $ 300,000 | $ 293,000 | $ 288,000 | $ 259,000 | $ 207,000 |

**Figure 19.8 Purchases Budget**

An operating expense budget is prepared next and is basically a prediction of the selling and administrative expenditures of the company. Notice in Figure 19.9 that in the operating expense budget, cost of goods sold (an expense) is not included, nor are noncash expenses such as depreciation. The cash outlays related to goods sold, at least in a merchandising operation, are accounted for in the purchases budget (payments for purchases of inventory.)

With the sales, purchases, and operating expense budgets prepared, the cash budget can be prepared. Some

of the “inputs” to the cash budget are from the sales (collections of cash), purchases (payments), and the operating expense budget (cash expenditures for selling and administrative expenses). A sample cash budget and a discussion of its preparation follows in the next section of this chapter.

## Sample Cash Budget

A cash budget is the last budget to be prepared and is often part of the financial budget (cash budget, budgeted income statement, and budgeted balance sheet). The purpose of the cash budget is to estimate cash flows, to help ensure sufficient cash balances are maintained during the planning period, and to plan for external financing during periods of cash deficits.

When a budget is prepared in Excel, cash budget analysts can play “what if” with different scenarios to see when cash surpluses and deficits are expected. Cash surpluses means that funds can be invested in marketable securities to earn a rate of return, while cash deficits mean that financing, such as a line of credit, will be necessary (assuming forecasts are accurate).

Although the example shown in Figure 19.10 is a monthly cash budget, a cash budget could be prepared using any useful time elements: weekly, monthly, or quarterly.

One common practice is to use a rolling cash budget. A rolling cash budget is continually updated to add a new budget period, such as a month’s amount of cash flow activity, as the most recent budgeted month expires. For example, assume that a 12-month cash budget is prepared for a period covering January 20X1 to December 20X1. Once the month of January 20X1 has concluded, a 12-month planning period continues by add January 20X2 to the last column of the budget. The rolling cash monthly budget is an extension of the initial cash budget model, adding one month and thereby always extending cash flow projections one year into the future.

| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| 1 | | **January** | **February** | **March** | **April** | **May** | **June** |
| 2 | **Wages and Salaries** | $200,000 | $200,000 | $200,000 | $200,000 | $200,000 | $200,000 |
| 3 | Payroll Taxes | 20,000 | 20,000 | 20,000 | 20,000 | 20,000 | 20,000 |
| 4 | Advertising and Marketing | 50,000 | 50,000 | 50,000 | 50,000 | 50,000 | 50,000 |
| 5 | Repairs and Maintenance | 12,000 | 12,000 | 12,000 | 12,000 | 12,000 | 12,000 |
| 6 | Rent | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 |
| 7 | Shipping | 5,520 | 6,000 | 7,200 | 6,480 | 5,832 | 6,415 |
| 8 | Utilities | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 |
| 9 | Insurance | 2,050 | 2,050 | 2,050 | 2,050 | 2,050 | 2,050 |
| 10 | Supplies | 400 | 400 | 400 | 400 | 400 | 400 |
| 11 | Taxes | 7,000 | 7,000 | 7,000 | 7,000 | 7,000 | 7,000 |
| 12 | **Total** | **$301,470** | **$301,950** | **$303,150** | **$302,430** | **$301,782** | **$302,365** |
| 13 | | | | | | | |
| 14 | | **July** | **August** | **September** | **October** | **November** | **December** |
| 15 | **Wages and Salaries** | $200,000 | $200,000 | $200,000 | $200,000 | $200,000 | $200,000 |
| 16 | Payroll Taxes | 20,000 | 20,000 | 20,000 | 20,000 | 20,000 | 20,000 |
| 17 | Advertising and Marketing | 50,000 | 60,000 | 60,000 | 55,000 | 50,000 | 50,000 |
| 18 | Repairs and Maintenance | 12,000 | 12,000 | 12,000 | 12,000 | 12,000 | 12,000 |
| 19 | Rent | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 |
| 20 | Shipping | 6,960 | 8,004 | 7,836 | 7,680 | 6,912 | 5,520 |
| 21 | Utilities | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 |
| 22 | Insurance | 2,050 | 2,050 | 2,050 | 2,050 | 2,050 | 2,050 |
| 23 | Supplies | 400 | 400 | 400 | 400 | 400 | 400 |
| 24 | Taxes | 7,000 | 7,000 | 7,000 | 7,000 | 7,000 | 7,000 |
| 25 | **Total** | **$302,910** | **$313,954** | **$313,786** | **$308,630** | **$302,862** | **$301,470** |

**Figure 19.9 Operating Expenses Budget**

| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| 1 | | **January** | **February** | **March** | **April** | **May** | **June** |
| 2 | **Beginning Cash Balance** | $350,000 | $258,530 | $191,880 | $131,730 | $154,300 | $152,218 |
| 3 | Cash Collections | 400,000 | 460,300 | 513,000 | 568,000 | 518,700 | 491,130 |
| 4 | Cash Disbursements | 491,470 | 526,950 | 573,150 | 545,430 | 520,782 | 543,365 |
| 5 | Net Cash Flow | (91,470) | (66,650) | (60,150) | 22,570 | (2,082) | (52,235) |
| 6 | Preliminary Ending Cash Balance | 258,530 | 191,880 | 131,730 | 154,300 | 152,218 | 99,983 |
| 7 | Less: Minimum Cash Balance | 50,000 | 50,000 | 50,000 | 50,000 | 50,000 | 50,000 |
| 8 | Cash Surplus (Deficiency) | $208,530 | $141,880 | $81,730 | $104,300 | $102,218 | $49,983 |
| 9 | **Ending Cash Balance** | **$258,530** | **$191,880** | **$131,730** | **$154,300** | **$152,218** | **$99,983** |
| 10 | | | | | | | |
| 11 | | **July** | **August** | **September** | **October** | **November** | **December** |
| 12 | **Beginning Cash Balance** | $99,983 | $69,901 | $50,000 | $89,024 | $129,784 | $179,772 |
| 13 | Cash Collections | 532,828 | 587,880 | 645,810 | 637,390 | 611,850 | 538,680 |
| 14 | Cash Disbursements | 562,910 | 613,954 | 606,786 | 596,630 | 561,862 | 508,470 |
| 15 | Net Cash Flow | (30,082) | (26,074) | 39,024 | 40,760 | 49,988 | 30,210 |
| 16 | Preliminary Ending Cash Balance | 69,901 | 43,827 | 89,024 | 129,784 | 179,772 | 209,982 |
| 17 | Less: Minimum Cash Balance | 50,000 | 50,000 | 50,000 | 50,000 | 50,000 | 50,000 |
| 18 | Cash Surplus (Deficiency) | $19,901 | ($6,173) | $39,024 | $79,784 | $129,772 | $159,982 |
| 19 | **Ending Cash Balance** | **$69,901** | **$50,000** | **$89,024** | **$129,784** | **$179,772** | **$209,982** |

**Figure 19.10 Sample Cash Budget**

Using Figure 19.9 as an example, Table 19.5 shows the formulas that form the skeleton of a monthly cash budget.

| | |
|---|---|
| Beginning Cash Balance | This is the amount of cash the company expects to have on the first day of the month. For example, in Figure 19.10, cell B2 is the amount of cash on Jan. 1 to start the year (the planning period). The remaining beginning cash balances for the months February through December are the ending cash balances of the previous month. For example, February's beginning cash balance (C2) is referenced from cell B9 (ending cash balance for January). |
| Cash Collections | These are the projected cash inflows from collections from customers (accounts receivable), cash sales, and any other significant cash inflows, such as dividends and interest on investments or sale of fixed assets. For example, the Cash Collections shown in the Sample Cash Budget (Figure 19.10) are referenced from the Sales and Collections Budget (Figure 19.7). January's Cash Collections (cell B3) in the Sample Cash Budget are from cell B12 of the Sales and Collection Budget. |
| Cash Disbursements | Cash disbursements are the projected cash outflows, such as those for operating expenses and payment of payables. For example, Cash Disbursements in the Sample Cash Budget for January (Figure 19.10) are the sum of January's payments for purchases in the Purchases Budget (Figure 19.8, cell B3) and the January operating expenses (Operating Expenses Budget, Figure 19.9, cell B12). |
| Net Cash Flow | The formula for net cash flow is For example, in Figure 19.10, the January Net Cash Flow is calculated in cell B5. |
| Preliminary Ending Cash Balance | Beginning Cash Balance + or - Net Cash Flow. This is the projected cash balance before taking into account the target cash balance to be maintained (minimum cash balance). In the Sample Cash Budget (Figure 19.10), the preliminary ending cash balance formula for January is =B2+B5 (B2 is the Beginning Cash Balance and B5 is the Net Cash Flow for the month). |
| Less: Minimum Cash Balance | This is a target cash balance that management sets; it is the minimum amount of cash that should be maintained by the company (in Figure 19.10, cells B2:G7 and B17:G17). |
| Cash Surplus (Deficiency) | A cash surplus means that cash can be invested in marketable securities. A cash deficiency means that some type of financing, such as a line of credit or bank loan, will be needed to provide enough cash for operations and to maintain a minimum cash balance. This number is found by subtracting the minimum cash balance from the preliminary ending cash balance. For example, the cash surplus for January in Figure 19.10 is calculated with this formula: =B6-B7. Notice that all months in the Sample Cash Budget show a surplus except for August's forecast of a deficit, which may require drawing on a line of credit to provide enough cash to meet obligations in August. |

**Table 19.5 Excel Formulas for Monthly Cash Budget**

# Summary

## 19.1 What Is Working Capital?

Working capital is not only necessary to run a business; it is a resource that will expand and contract with business cycles and must be carefully managed and monitored. The daily, weekly, and monthly needs of business operations are met by cash. Financial managers understand the significance of net working capital (current assets – current liabilities) and various liquidity ratios as they attempt to ensure that bills can be paid. The cash conversion cycle and the cash budget provide additional working capital management tools.

## 19.2 What Is Trade Credit?

Trade credit is very prevalent in the business world, especially in B2B (business-to-business) transactions. Many business exchanges (sales) could not take place without trade credit and the credit terms that are offered. Like any component of working capital, trade credit must be planned and managed. The creditor (the company granting the credit) does so based on an analysis of creditworthiness and must monitor payments and manage slow-paying accounts. The debtor (accounts payable) needs to make payments on time to keep a clean credit history and to take advantage of discounts.

## 19.3 Cash Management

Cash management is simply making sure you have enough cash to meet expected obligations and for contingencies (unexpected or emergency cash needs). Excess cash should be invested low-risk and highly liquid marketable securities. The cash budget is a critical tool of cash management.

## 19.4 Receivables Management

Accounts receivables are monitored by management with tools such as the ratios accounts receivable turnover and average collection period and the aging of receivables. The credit managers' mantra rings true: "The older the receivable, the greater the likelihood that the account will not be collected."

## 19.5 Inventory Management

Inventory, usually the least liquid of the current assets, presents its own set of management challenges. Finding the optimal level of inventory is probably more of an art than a science. JIT helps to reduce the investment in inventory and lower the costs of storage, but stockout costs can be very damaging to profitability.

## 19.6 Using Excel to Create the Short-Term Plan

Short-term plans of a business are funded with cash, with cash budgets being a critical tool of planning. The cash budget takes into account a target amount of cash, factoring in all the motives for holding cash. A cash budget looks ahead—predicting cash inflows and outflows, allocating for minimum cash balances to be maintained, and helping management determine short-term financing needed. Although it is the last budget prepared, the preparation of the cash budget is an important financial planning exercise of companies small and large.

# Key Terms

**accounts receivable aging schedule** a report that shows amounts owed by customers by the age of the account, as measured by the number of days since the sale

**allowance for doubtful accounts** an account that contains the estimated amount of accounts receivable that will not be collected

**bad debt expense** an expense that a business incurs as a result of uncollectible accounts receivables

**bankruptcies** federal court procedures that protect distressed businesses from creditor collection efforts while allowing the debtor firm to liquidate its assets or devise a reorganization plan

**benchmarking** the process of performance analysis that involves comparing financial condition and operating results against a standard, called a benchmark

**bill of lading** a document that is a detailed list of a goods that have been shipped; a receipt given by the carrier (shipping company) to the seller as evidence that the goods have been shipped to the buyer

**carrying costs** all costs associated with having inventory in stock including storage costs, insurance, inventory obsolescence, and spoilage

**cash budget** a report that shows an estimation of cash inflows, outflows, and cash balances over a specific period of time, such as monthly, quarterly, or annually

**cash cycle or cash conversion cycle** the time period (measured in days) between when a business begins production and acquires resources from its suppliers (for example, acquisition of materials and other forms of inventory) and when it receives cash from its customers; offset by the time it takes to pay suppliers (called the payables deferral period)

**cash discount** discount granted to a customer who has purchased goods or services on account (credit) and pays the invoice within a certain number of days as specified by credit terms

**compensating balance** minimum balance of cash that a business must deposit and maintain in a bank account to obtain a loan

**contra-asset** an account with a balance that is used to offset (reduce) its related asset on the balance sheet (for example, allowance for doubtful accounts reduces the value of accounts receivable reported on the balance sheet)

**credit period** the number of days that a business purchaser has before they must pay their invoice

**credit rating** a type of score that indicates a business's creditworthiness

**credit terms** the terms that are part of a sales credit agreement that indicate when payment is due, possible discounts, and any fees that will be charged for a late payment

**current assets** assets that are cash or cash equivalents or are expected to be converted to cash in a short period of time and will be consumed, used, or expire through business operations within one year or the business's operating cycle, whichever is shorter

**discount period** the number of days the buyer has to take advantage of the cash discount for an early payment

**factoring** the process of selling accounts receivables to a financial institution or, in some cases, using the accounts receivables as security for a loan from a financial institution

**floor planning** a type of inventory financing whereby a financial institution provides a loan so that the company can acquire inventory with proceeds from the sale of inventory used to pay down the loan; a common method of financing inventory for automobile dealers and sellers of other big-ticket (high-priced) items

**gross working capital** synonymous with the current assets of a company, those assets that include cash and other assets that can be converted into cash within a period of 12 months

**just-in-time inventory** inventory management method in which a company maintains as little inventory on hand as possible while still being able to satisfy the demands of its customers

**letter of credit** a letter issued by a bank that is evidence of a guarantee for payments made to a specified entity (such as a supplier) under specified conditions; common in international trade transactions

**liquidity** ability to convert assets into cash in order to meet primarily short-term cash needs or emergencies

**marketable securities** investments that can be converted to cash quickly; short-term liquid securities that can be bought or sold on a public exchange (market) and tend to mature in a year or less

**net terms** also referred to as the full credit period; the number of days that a business purchaser has before they must pay their invoice

**net working capital** the difference between current assets and current liabilities (Current Assets – Current Liabilities = Net Working Capital)

**operating cycle** the time it takes a company to acquire inventory, sell inventory, and collect the cash from the sale of said goods; synonymous with cash cycle

**opportunity cost** the cost of a forgone opportunity

**ordering costs** costs associated with placing an order with a vendor or supplier

**precautionary motive** a reason to hold cash balances for unexpected expenditures such as repairs, costs associated with unexpected breakdown of equipment, and hiring temporary workers to meet unexpected production demands

**quick payment** a payment made on an account payable during a period of time that falls within the discount period

**ratios** numerical values taken from financial statements that are used in formulas to examine financial relationships and create metrics of performance, strengths, weaknesses; help analysts gain insight and meaning

**speculative motive** a reason for holding an amount of cash—to be able to take advantage of investment opportunities

**stockout costs** an opportunity cost (lost revenue) incurred when a customer order cannot be filled because the item is out of stock and the customer goes elsewhere for the product

**supply chain** the network of participants and activities between a company and its suppliers and the company and its customers; exists to distribute a product or to provide a service to the final buyer

**trade credit** credit granted to a business, also called accounts payable; allows a business to buy goods and services on account and pay the cash at some point in the future

**transactional motive** holding an amount of cash to meet operational expenditures such as payroll, payments to vendors, and loan payments

**working capital** the resources that are needed to meet the daily, weekly, and monthly operating cash flow needs

## Multiple Choice

1. The term *working capital* is synonymous with _____.
   **a.** accounts payable
   **b.** current assets
   **c.** equity
   **d.** current liabilities

2. The formula for net working capital is _____.
   **a.** Current Assets – Current Liabilities
   **b.** Fixed Assets – Current Assets
   **c.** Assets – Liabilities
   **d.** Current Assets – Liabilities

3. When sales are made on credit, which current assets typically increase at the time of the sale?
   **a.** cash
   **b.** notes receivable
   **c.** accounts receivable
   **d.** marketable securities

4. Which of the following is NOT a goal of working capital management?
   **a.** meet the operational needs of the company
   **b.** satisfy obligations (current liabilities) as they come due
   **c.** maintain an optimal level of current assets
   **d.** maximize the investment in current assets

5. Accelerated Growth Inc. has the following account balances at year-end.

| | |
|---|---|
| Property, Plant, and Equipment | $500,000 |
| Accounts Payable | 6,000 |
| Intangible Assets | 5,000 |
| Cash | 10,000 |
| Marketable Securities (maturing in 6 months or less) | 30,000 |
| Retained Earnings | 25,000 |
| Interest Payable | 2,000 |
| Notes Payable (due in 24 months) | 10,000 |
| Accounts Receivable | 20,000 |
| Notes Payable (due in 6 months) | 20,000 |
| Common Stock | 45,000 |
| Dividends Payable | 3,000 |
| Inventory | $ 50,000 |

What is the cash ratio?

**a.** 1.29
**b.** 1.43
**c.** 1.71
**d.** .088

**6**. Which of the following is true of these credit terms: 3/15, n/30?
**a.** 15 percent discount if the payable is paid within 3 days of the invoice date
**b.** 3 percent discount if the payable is paid in the period between 15 days and 30 days after the invoice date
**c.** 3 percent discount if the payable is paid within 15 days of the invoice date
**d.** 30 percent discount if cash is paid on the sale date and 15% discount if paid 3 days after the invoice date

**7**. When reviewing its budgets, including the cash budget, management of Transcend Inc. have considered best-case and worst-case scenarios. As they completed their analysis, it was decided because of the possibility of unexpected repairs and unanticipated higher labor costs to add another $30,000 to the amount of the target cash balance to maintain throughout the year. The reason for this action would be which of these motives for holding cash?
**a.** transaction motive
**b.** opportunity cost mitigation motive
**c.** precautionary motive
**d.** speculative motive

**8**. A large retailer has more than $100 million of cash and cash equivalents on its balance sheet. Which of the following would not be part of the cash equivalents?
**a.** cash in banks (checking account balances)
**b.** US Treasury bond maturing in two years
**c.** receivables from a bank that processes credit card payments
**d.** commercial paper

**9**. An account receivable is created when _____.
**a.** a customer pays its bill
**b.** a company accepts a credit card, such as VISA or MasterCard
**c.** a company sells to a customer on an open account
**d.** a company sells to a customer only on a cash basis

**10**. Jackson's Moonshine LLC has a receivables collection period of 47 days. Which the following would be reasonable conclusions?

**a.** Jackson's Moonshine LLC is most likely experiencing serious liquidity issues.
**b.** Jackson's Moonshine LLC is most overinvested in marketable securities.
**c.** If the industry average is 31 days, Jackson's management should attempt strategies that will lower their receivables collection period.
**d.** If the industry average is 53 days, Jackson's management should attempt strategies that will raise their receivables collection period.

**11.** Two Way Power Ltd. (2WP) stocks an inventory item, BB3, that is projected to be in great demand over the next 12 months. In discussing its sales forecasts with its suppliers, a reasonable estimate shows that 2WP could lose about $30,000 of sales in month 3 due to inventory financing difficulties. Which, if any, of the following inventory costs would be affected by this development?
**a.** purchase cost
**b.** carrying costs
**c.** ordering costs
**d.** stockout costs
**e.** none of these costs because loss of sales is not an inventory cost

**12.** If a company has significant inventory in each element of the value chain, it most likely is descriptive of _____.
**a.** the cost of goods sold of a retailer
**b.** the inventory balances held by wholesalers and service firms
**c.** the materials, work in process, and finished goods of a manufacturer
**d.** the inventory on the shelves of an e-commerce retailer

## Review Questions

**1.** Intelligent Cookies Inc. (ICI) sold $30,000,000 of product in a year that had a cost of goods sold of $10,000,000. The average inventory carried by ICI was $500,000. On average, it takes 35 days for ICI's customers, such as grocery stores and restaurants, to pay on their accounts. ICI buys ingredients, including flour, spices, and eggs, from its vendors on credit, and ICI takes about 40 days to pay its suppliers. How many days is ICI's cash conversion cycle?

**2.** Shown below are account balances for Electra Engines Inc., a manufacturer. The accounts are shown in a random order. What is the amount of net working capital?

Net Working Capital $_____

| | |
|---|---|
| Property, Plant, and Equipment | $500,000 |
| Accounts Payable | 6,000 |
| Intangible Assets | 5,000 |
| Cash | 10,000 |
| Marketable Securities (maturing in 6 months or less) | 30,000 |
| Retained Earnings | 25,000 |
| Interest Payable | 2,000 |
| Notes Payable (due in 24 months) | 10,000 |
| Accounts Receivable | 20,000 |
| Notes Payable (due in 6 months) | 20,000 |
| Common Stock | 45,000 |
| Dividends Payable | 3,000 |
| Inventory | $ 50,000 |

**3.** Shown below are account balances for Electra Engines Inc., a manufacturer. The accounts are shown in a random order. What is the current ratio and the quick ratio?

| | |
|---|---|
| Property, Plant, and Equipment | $500,000 |
| Accounts Payable | 9,000 |
| Intangible Assets | 5,000 |
| Cash | 12,000 |
| Marketable Securities (maturing in 6 months or less) | 25,000 |
| Retained Earnings | 25,000 |
| Interest Payable | 2,500 |
| Notes Payable (due in 24 months) | 10,000 |
| Accounts Receivable | 25,000 |
| Notes Payable (due in 6 months) | 20,000 |
| Common Stock | 45,000 |
| Dividends Payable | 3,000 |
| Inventory | 55,000 |

4. Imagine that these are the cash collection cycles for some well-run companies:

| Company | Cash Conversion Cycle |
|---|---|
| Grocery Chain | 6.20 |
| Building/Construction Company | 162.69 |
| Restaurant Chain | (4.06) |
| Department Store | 63.60 |

What types of conclusions can you reach when you see this kind of variability?

Imagine that those cash conversion cycles are based on this information:

| Company Type | Inventory Turnover | Accounts Receivable Turnover | Accounts Payable Turnover |
|---|---|---|---|
| Grocery Chain | 14.60 | 91.00 | 16.00 |
| Building/Construction Company | 2.00 | 121.67 | 16.00 |
| Restaurant Chain | 150.00 | 100.00 | 36.00 |
| Department Store | 2.78 | 91.00 | 3.00 |

What would be your analysis of the cash conversion cycles based on the above information (inventory turnover, accounts receivable turnover, and accounts payable turnover)? Use the worksheet below to summarize your conclusions.

Worksheet

| Company | Cash Conversion Cycle | Analysis |
|---|---|---|
| Grocery Chain | 6.20 | |
| Building/Construction Company | 162.69 | |
| Restaurant Chain | (4.06) | |
| Department Store | 63.60 | |

5. What is the estimated annual percentage rate (APR) of not taking advantage of the early payment discount based on these terms: 4/15, n/45?

6. If you were a credit manager reviewing a potential customer's request for a $20,000 line of credit, what would you analyze? Generally, how would the 5Cs of Credit guide your analysis and help lead you to a

prudent decision to accept or reject the request?

7. Aspire Excellent Inc. is a book publisher. On March 1, Aspire sells $25,000 of books to Get Your Books Inc. (YBI), a large bookstore chain. The sale is made on account with terms net 60. Aspire's customers usually take the full 60 days to pay their invoices. The books cost Aspire $10,000 to manufacture. Below, summarize the effect on the accounts on March 1 from the standpoint of the seller, Aspire Excellent Inc., and the buyer, YBI.

| Aspire's Accounts | Change (Amount and Direction of Change: + or –) in the Account |
|---|---|
| Accounts Receivable | |
| Inventory | |
| Sales | |
| **YBI's Accounts** | **Change (Amount and Direction of Change: + or –) in the Account** |
| Accounts Payable | |
| Inventory | |

8. The financial manager of New England Blissful Dairies, a distributor of milk, cream, and ice cream products, has finished the 12-month operating budget. For the month of June, the following projections were made:
June 1 Cash Balance $90,000
Cash Receipts $300,000
Cash Disbursement $350,000

Taking into account an amount of cash that the firm likes to maintain as a target (minimum cash balance) of $75,000, prepare the cash budget for June using the format below. Assume that, if necessary, the company will draw upon a preestablished line of credit with their bank to be able to maintain the target cash balance.

| | June |
|---|---|
| Beginning Cash Balance | |
| Cash Collections | |
| Cash Disbursements | |
| Net Cash Flow | |
| Preliminary Ending Cash Balance | |
| Less: Minimum Cash Balance | |
| Cash Surplus (Deficiency) | |
| Ending Cash Balance | |

Will the company need short-term financing?

9. The sales for Re-Works Inc., a company that fabricates iron fencing from recycled metals, are all on account. For the first three months of the year, Re-Works management expects the following sales:

| | Sales |
|---|---|
| January | $120,000 |
| February | $130,000 |
| March | $140,000 |

Based on past collection patterns, management expects the following:

| | |
|---|---|
| Month of Sale | 10% |
| Month after Sale | 50% |
| Remainder - Second Month after Sale | 40% |

Also, based on past experience, management forecasts that 5 percent of accounts receivable will be uncollectible and will eventually be written off.

What are the expected cash receipts for March?

**10.** With the same sales forecasts as in question 9, Re-Works Inc. management would like to implement some changes to credit policy and credit terms that they believe would change the collection pattern going forward and would lower the uncollectible accounts prediction to 3 percent.
What would be the expected cash receipts for March?

| | |
|---|---|
| Month of Sale | 15% |
| Month after Sale | 55% |
| Remainder | 30% |
| Bad Debt Expense | 3% |

# Video Activity

## How Companies Report Cash Flow

Access multimedia content (http://openstax.org/books/principles-finance/pages/19-video-activity)

1. Why isn't the net income reported on a corporate balance sheet a good estimate of the increase in cash that occurred during the year?
2. What is the difference between a corporate cash budget and a projected statement of cash flows?

## Trade Credit and Interest Rates on Short-Term Borrowing

Access multimedia content (http://openstax.org/books/principles-finance/pages/19-video-activity)

3. Explain this statement: Accounts payable and accounts receivables are essentially financial opposites.
4. Accounts payable is often called "interest-free financing." As such, explain why a company would choose to pay the amount owed on its purchases of inventory 50 days early. Base your answer on these facts:
   - The annualized cost of forgoing an early payment discount is approximately 16 percent.
   - The company's cost of borrowing short-term on a bank line of credit is 9 percent.

20

# Risk Management and the Financial Manager

**Figure 20.1** Financial managers must consider prudent ways to manage economic volatility and the risk it poses to a company. (credit: modification of "Risk text on Dollar banknotes" by Marco Verch/flickr CC BY 2.0)

## Chapter Outline

**20.1** The Importance of Risk Management
**20.2** Commodity Price Risk
**20.3** Exchange Rates and Risk
**20.4** Interest Rate Risk

## Why It Matters

Each year, American Airlines consumes approximately four billion gallons of jet fuel.[1] In the spring of 2018, jet fuel prices rose from an average of $2.07 per gallon to a price of $2.19 per gallon.[2] A $0.12-per-gallon increase in the price of jet fuel may not seem significant, but on an annualized basis, a price increase of this magnitude would increase the company's jet fuel bill by approximately $500 million.

That added cost cuts into the profits of the company, leaving less money available to provide a return to the company's investors. Rising costs could even cause the business to become unprofitable and close, causing many employees to lose their jobs. The financial managers of American Airlines are not able to control the price of jet fuel. However, they must be aware of the risk that price volatility poses to the company and consider prudent ways to manage this risk.

1 American Airlines. *American Airlines 2019 Environmental Data*. Accessed July 8, 2021. https://www.americanairlines.in/content/images/customer-service/about-us/corporate-governance/aag-2019-environmental-data.pdf
2 S&P Global. "Platts Jet Fuel." *S&P Global Platts*. Accessed July 8, 2021. https://www.spglobal.com/platts/en/oil/refined-products/jetfuel#

# 20.1 The Importance of Risk Management

## Learning Outcomes

By the end of this section, you will be able to:

- Describe risk in the context of financial management.
- Explain how risk can impact firm value.
- Distinguish between hedging and speculating.

## What Is Risk?

The job of the financial manager is to maximize the value of the firm for the owners, or shareholders, of the company. The three major areas of focus for the financial manager are the size, the timing, and the riskiness of the cash flows of the company. Broadly, the financial manager should work to

- increase cash coming into the company and decrease cash going out of the company;
- speed up cash coming into the company and slow down cash going out of the company; and
- decrease the riskiness of both money coming in and money going out of the company.

The first item in this list is obvious. The more revenue a company has, the more profitable it will be. Businesspeople talk about "top line" growth when discussing this objective because revenue appears at the top of the company's income statement. Also, the lower the company's expenses, the more profitable the company will be. When businesspeople talk about the "bottom line," they are focused on what will happen to a company's net income. The net income appears at the bottom of the income statement and reflects the amount of revenue left over after all of the company's expenses have been paid.

The second item in the list—the speed at which money enters and exits the company—has been addressed throughout this book. One of the basic principles of finance is the time value of money—the idea that a dollar received today is more valuable than a dollar received tomorrow. Many of the topics explored in this book revolve around the issue of the time value of money.

The focus of this chapter is on the third item in the list: risk. In finance, risk is defined as uncertainty. Risk occurs because you cannot predict the future. Compared to other business decisions, financial decisions are generally associated with contracts in which the parties of the contract fulfill their obligations at different points in time. If you choose to purchase a loaf of bread, you pay the baker for the bread as you receive the bread; no future obligation arises for either you or the baker because of this purchase. If you choose to buy a bond, you pay the issuer of the bond money today, and in return, the issuer promises to pay you money in the future. The value of this bond depends on the likelihood that the promise will be fulfilled.

Because financial agreements often represent promises of future payment, they entail risk. Even if the party that is promising to make a payment in the future is ethical and has every intention of honoring the promise, things can happen that can make it impossible for them to do so. Thus, much of financial management hinges on managing this risk.

## Risk and Firm Value

You would expect the managers of Starbucks Corporation to know a lot about coffee. They must also know a lot about risk. It is not surprising that the term *coffee* appears in the text of the company's 2020 annual report 179 times, given that the company's core business is coffee. It might be surprising, however, that the term *risk* appears in the report 99 times.[3] Given that the text of the annual report is less than 100 pages long, the word *risk* appears, on average, more than once per page.

Starbucks faces a number of different types of risk. In 2020, corporations experienced an unprecedented risk because of COVID-19. Coffee shops were forced to remain closed as communities experienced government-

3 Starbucks. *Starbucks Fiscal 2020 Annual Report.* Seattle: Starbucks Corporation, 2020. https://s22.q4cdn.com/869488222/files/doc_financials/2020/ar/2020-Starbucks-Annual-Report.pdf

mandated lockdowns. Locations that were able to service customers through drive-up windows were not immune to declining revenue due to the pandemic. As fewer people gathered in the workplace, Starbucks experienced a declining number of to-go orders from meeting attendees. In addition, Starbucks locations faced the risk of illness spreading as baristas gathered in their buildings to fill to-go orders.

While COVID-19 brought discussions of risk to the forefront of everyday conversations, risk was an important focus of companies such as Starbucks before the pandemic began. (The term *risk* appeared in the company's 2019 annual report 82 times.[4]) Starbucks's business model revolves around turning coffee beans into a pleasurable drink. Anything that impacts the company's ability to procure coffee beans, produce a drink, and sell that drink to the customer will impact the company's profitability.

The investors in the company have allowed Starbucks to use its capital to lease storefronts, purchase espresso machines, and obtain all of the assets necessary for the company to operate. Debt holders expect interest to be paid and their principal to be returned. Stockholders expect a return on their investment. Because investors are risk averse, the riskier they perceive the cash flows they will receive from the business to be, the higher the expected return they will require to let the company use their money. This required return is a cost of doing business. Thus, the riskier the cash flows of a company, the higher the cost of obtaining capital. As any cost of operating a business increases, the value of the firm declines.

### LINK TO LEARNING

#### Starbucks

The most recent annual report for Starbucks Corp., along with the reports from recent years, is available on the company's investor relations website under the Financial Data section (https://openstax.org/r/Financial_Data_section). Go to the most recent annual report for the company. Search for the word *risk* in the annual report, and read the discussions surrounding this topic. Note the major types of risk the company discusses. Pay attention to the types of risk that Starbucks categorizes as uncontrollable and which types of risk the company attempts to mitigate.

In the following sections, you will learn about some of the types of risk that firms commonly face. You will also learn about ways in which firms can reduce their exposure to these risks. When firms take actions to reduce their exposures to risk, they are said to be **hedging**. Firms hedge to try to protect themselves from losses. Thus, in finance, hedging is a risk management tool.

Certain strategies are commonly used by firms to hedge risk, which is part of corporate financial management. Many of these same strategies can be used by economic players who wish to speculate. **Speculating** occurs when someone bets on a future outcome. It involves trying to predict the future and profit off of that prediction, knowing that there is some risk that an incorrect prediction will lead to a loss. Speculators bet on the future direction of an asset price. Thus, speculation involves directional bets.

If you are concerned that the price of hand sanitizer is going to rise because people are concerned about a new virus and you purchase a few extra bottles to keep on your shelf "just in case," you are hedging. If you see this situation as a business opportunity and purchase bottles of hand sanitizer, hoping that you can sell them on eBay in a few weeks at twice what you paid for them, you are speculating.

In the popular press, you will often hear of some of the strategies in this chapter discussed in terms of people using them to speculate. In upper-level finance courses, these strategies are discussed in more depth, including how they might be used to speculate. In this chapter, however, the focus is on the perspective of a financial manager using these strategies to manage risk.

4 Starbucks. *Starbucks Fiscal 2019 Annual Report.* Seattle: Starbucks Corporation, 2019. https://s22.q4cdn.com/869488222/files/doc_financials/2019/2019-Annual-Report.pdf

# 20.2 Commodity Price Risk

## Learning Outcomes

By the end of this section, you will be able to:

- Describe commodity price risk.
- Explain the use of long-term contracts as a hedge.
- Explain the use vertical integration as a hedge.
- Explain the use of futures contracts as a hedge.

One of the most significant risks that many companies face arises from normal business operations. Companies purchase raw materials to produce the products and provide the services they sell. A change in the market price of these raw materials can significantly impact the profitability of a company.

For example, Starbucks must purchase coffee beans in order to make its coffee drinks. The price of coffee beans is highly volatile. Sample prices of a pound of Arabica coffee beans over the past couple of decades are shown in Table 20.1. Over this period, the price of coffee beans ranged from a low of $0.52 per pound in the summer of 2002 to a high of over $3.00 per pound in the spring of 2011. The costs, and thus the profits, of Starbucks will vary greatly depending on if the company is paying less than $1.00 per pound for coffee or if it is paying three times that much.

| Date | Price per Pound ($) |
|---|---|
| January 1, 2000 | 1.09 |
| January 1, 2004 | 0.74 |
| January 1, 2008 | 1.39 |
| January 1, 2012 | 2.41 |
| January 1, 2016 | 1.46 |
| January 1, 2020 | 1.50 |

**Table 20.1 Price of Coffee in Select Years, 2000-2020**[5]

## Long-Term Contracts

One method of hedging the risk of volatile input prices is for a firm to enter into long-term contracts with its suppliers. Starbucks, for example, could enter into an agreement with a coffee farmer to purchase a particular quantity of coffee beans at a predetermined price over the next several years.

These long-term contracts can benefit both the buyer and the seller. The buyer is concerned that rising commodity prices will increase its cost of goods sold. The seller, however, is concerned that falling commodity prices will mean lower revenue. By entering into a long-term contract, the buyer is able to lock in a price for its raw materials and the seller is able to lock in its sales price. Thus, both parties are able to reduce uncertainty.

While long-term contracts reduce uncertainty about the commodity price, and thus reduce risk, there are several possible disadvantages to these types of contracts. First, both parties are exposed to the risk that the other party may default and fail to live up to the terms of the contract. Second, these contracts cannot be entered into anonymously; the parties to the contract know each other's identity. This lack of anonymity may have strategic disadvantages for some firms. Third, the value of this contract cannot be easily determined, making it difficult to track gains and losses. Fourth, canceling the contract may be difficult or even impossible.

5 Data from International Monetary Fund. "Global Price of Coffee, Other Mild Arabica (PCOFFOTMUSDM)." FRED. Federal Reserve Bank of St. Louis, accessed August 6, 2021. https://fred.stlouisfed.org/series/PCOFFOTMUSDM

## Vertical Integration

A common method of handling the risk associated with volatile input prices is **vertical integration**, which involves the merger of a company and its supplier. For Starbucks, a vertical integration would involve Starbucks owning a coffee bean farm. If the price of coffee beans rises, the firm's costs increase and the supplier's revenues rise. The two companies can offset these risks by merging.

Although vertical integration can reduce commodity price risk, it is not a perfect hedge. Starbucks may decrease its commodity price risk by purchasing a coffee farm, but that action may expose it to other risks, such as land ownership and employment risk.

## Futures Contracts

Another method of hedging commodity price risk is the use of a futures contract. A commodity futures contract is designed to avoid some of the disadvantages of entering into a long-term contract with a supplier. A **futures contract** is an agreement to trade an asset on some future date at a price locked in today. Futures exist for a range of commodities, including natural resources such as oil, natural gas, coal, silver, and gold and agricultural products such as soybeans, corn, wheat, rice, sugar, and cocoa.

Futures contracts are traded anonymously on an exchange; the market price is publicly observable, and the market is highly liquid. The company can get out of the contract at any time by selling it to a third party at the current market price.

A futures contract does not have the credit risk that a long-term contract has. Futures exchanges require traders to post **margin** when buying or selling commodities futures contracts. The margin, or collateral, serves as a guarantee that traders will honor their obligations. Additionally, through a procedure known as **marking to market**, cash flows are exchanged daily rather than only at the end of the contract. Because gains and losses are computed each day based on the change in the price of the futures contract, there is not the same risk as with a long-term contract that the counterparty to the contract will not be able to fulfill their obligation.

### THINK IT THROUGH

#### The CME Group

In 2007, the Chicago Mercantile Exchange merged with the Chicago Board of Trade to form CME Group Inc. CME Group provides trading in futures as well as other types of contracts that companies can use to hedge risk.

You can watch the video Getting Started with Your Broker (https://openstax.org/r/Getting_Started_with_Your_Broker) to learn how futures contracts for agricultural products such as coffee beans, corn, wheat, and soybeans are traded. You will also see other types of futures contracts traded, including futures for silver, crude oil, natural gas, Japanese yen, and Russian rubles.

# 20.3 Exchange Rates and Risk

## Learning Outcomes

By the end of this section, you will be able to:

- Describe exchange rate risk.
- Identify transaction, translation, and economic risks.
- Describe a natural hedge.
- Explain the use of forward contracts as a hedge.
- List the characteristics of an option contract.
- Describe the payoff to the holder and writer of a call option.
- Describe the payoff to the holder and writer of a put option.

The managers of companies that operate in the global marketplace face additional complications when managing the riskiness of their cash flows compared to domestic companies. Managers must be aware of differing business climates and customs and operate under multiple legal systems. Often, business must be conducted in multiple languages. Geopolitical events can impact business relationships. In addition, the company may receive cash flows and make payments in multiple currencies.

## Exchange Rates

The costs to companies are impacted when the prices of the raw materials they use change. Very little coffee is grown in the United States. This means that all of those coffee beans that Starbucks uses in its espresso machines in Seattle, New York, Miami, and Houston were bought from suppliers outside of the United States. Brazil is the largest coffee-producing country, exporting about one-third of the world's coffee.[6] When a company purchases raw materials from a supplier in another country, the company needs not just money but the money that is used in that country to make the purchase. Thus, the company is concerned about the **exchange rate**, or the price of the foreign currency.

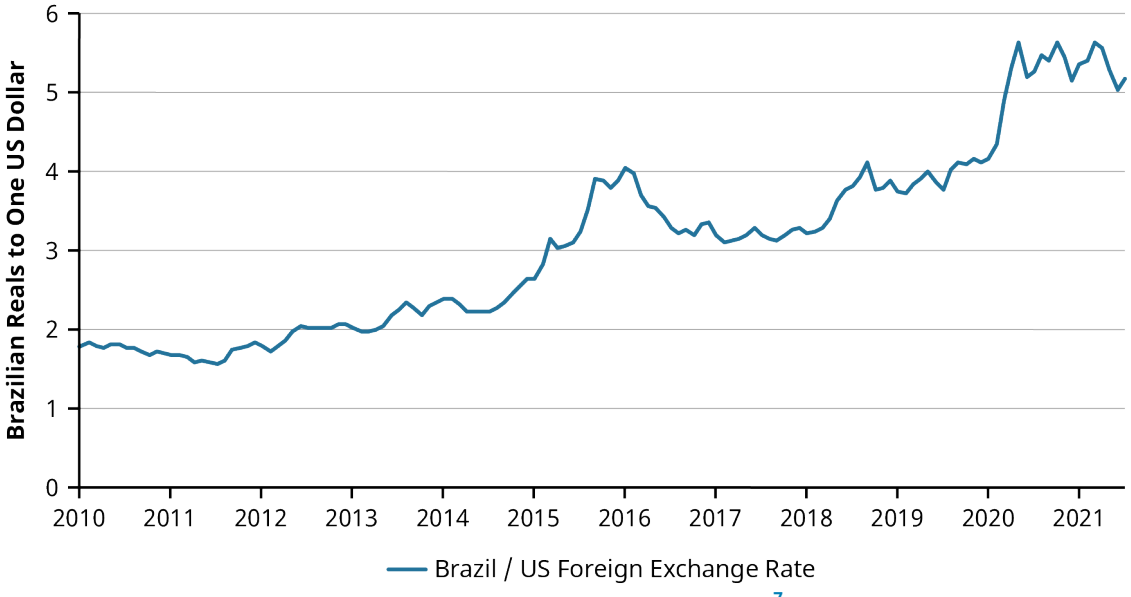



**Figure 20.2 Brazilian Reals to One US Dollar**[7]

The currency used in Brazil is called the Brazilian real. Figure 20.2 shows how many Brazilian reals could be purchased for $1.00 from 2010 through the first quarter of 2021. In March 2021, 5.4377 Brazilian reals could be purchased for $1.00. This will often be written in the form of

6 Global Agricultural Information Network. *Brazil: Coffee Annual 2019*. GAIN Report No. BR19006. Washington, DC: USDA Foreign Agricultural Service, May 2019. https://apps.fas.usda.gov/newgainapi/api/report/downloadreportbyfilename?filename=Coffee%20Annual_Sao%20Paulo%20ATO_Brazil_5-16-2019.pdf

$$\text{USD } 1 = \text{BRL } 5.4377 \tag{20.1}$$

BRL is an abbreviation for Brazilian real, and USD is an abbreviation for the US dollar. This price is known as a currency exchange rate, or the rate at which you can exchange one currency for another currency.

If you know the price of $1.00 is 5.4377 Brazilian reals, you can easily find the price of Brazilian reals in US dollars. Simply divide both sides of the equation by 5.4377, or the price of the US dollar:

$$\begin{aligned} \text{USD } 1 &= \text{BRL } 5.4377 \\ \frac{\text{USD } 1}{5.4377} &= \frac{\text{BRL } 5.4377}{5.4377} \\ \text{USD } 0.1839 &= \text{BRL } 1 \end{aligned} \tag{20.2}$$

If you have US dollars and want to purchase Brazilian reals, it will cost you $0.1839 for each Brazilian real you want to buy.

The foreign exchange rate changes in response to demand for and supply of the currency. In early 2020, the exchange rate was $\text{USD } 1 = \text{BRL } 4$. In other words, $1 purchased fewer reals in early 2020 than in it did a year later. Because you receive more reals for each dollar in 2021 than you would have a year earlier, the dollar is said to have **appreciated** relative to the Brazilian real. Likewise, because it takes more Brazilian reals to purchase $1.00, the real is said to have **depreciated** relative to the US dollar.

## Exchange Rate Risks

Starbucks, like other firms that are engaged in international business, faces currency exchange rate risk. Changes in exchange rates can impact a business in several ways. These risks are often classified as transaction, translation, or economic risk.

### Transaction Risk

**Transaction risk** is the risk that the value of a business's expected receipts or expenses will change as a result of a change in currency exchange rates. If Starbucks agrees to pay a Brazilian coffee grower seven million Brazilian reals for an order of one million pounds of coffee beans, Starbucks will need to purchase Brazilian reals to pay the bill. How much it will cost Starbucks to purchase these Brazilian reals depends on the exchange rate at the time Starbucks makes the purchase.

In March 2021, with an exchange rate of $\text{USD } 0.1839 = \text{BRL } 1$, it would have cost Starbucks $\$0.1839 \times 7{,}000{,}000 = \$1{,}287{,}300$ to purchase the reals needed to receive the one million pounds of coffee beans. If, however, Starbucks agreed in March to purchase the coffee beans several months later, in July, Starbucks would not have known then what the exchange rate would be when it came time to complete the transaction. Although Starbucks would have locked in a price of BRL 7,000,000 for one million pounds of coffee beans, it would not have known what the coffee beans would cost the company in terms of US dollars.

If the US dollar appreciated so that it cost less to purchase each Brazilian real in July, Starbucks would find that it was paying less than $1,287,300 for the coffee beans. For example, suppose the dollar appreciated so that the exchange rate was $\text{USD } 0.1800 = \text{BRL } 1$ in July 2021. Then the coffee beans would only cost Starbucks $\$0.1800 \times 7{,}000{,}000 = \$1{,}260{,}000$.

On the other hand, if the US dollar depreciated and it cost more to purchase each Brazilian real, then Starbucks would find that its dollar cost for the coffee beans was higher than it expected. If the US dollar depreciated (and the Brazilian real appreciated) so that the exchange rate was $\text{USD } 0.2000 = \text{BRL } 1$ in July 2021, then the coffee beans would cost Starbucks $\$0.2000 \times 7{,}000{,}000 = \$1{,}400{,}000$. This uncertainty regarding the dollar cost of the coffee beans Starbucks would purchase to make its lattes is an example of transaction risk.

7 Data from Board of Governors of the Federal Reserve System (US). "Brazil / US Foreign Exchange Rate (DEXBZUS)." FRED. Federal Reserve Bank of St. Louis, accessed August 6, 2021. https://fred.stlouisfed.org/series/DEXBZUS

A global company such as Starbucks has transaction risk not only because it is purchasing raw materials in foreign countries but also because it is selling its product—and thus collecting revenue—in foreign countries. Customers in Japan, for example, spend Japanese yen when they purchase a Starbucks cappuccino, coffee mug, or bag of coffee beans. Starbucks must then convert these Japanese yen to US dollars to pay the expenses that it incurs in the United States to produce and distribute these products.

The Japanese yen–US dollar foreign exchange rates from 2011 through the first quarter of 2021 are shown in Figure 20.3. In 2012, $1.00 could be purchased with fewer than 80 Japanese yen. In 2015, it took over 120 yen to purchase $1.00.

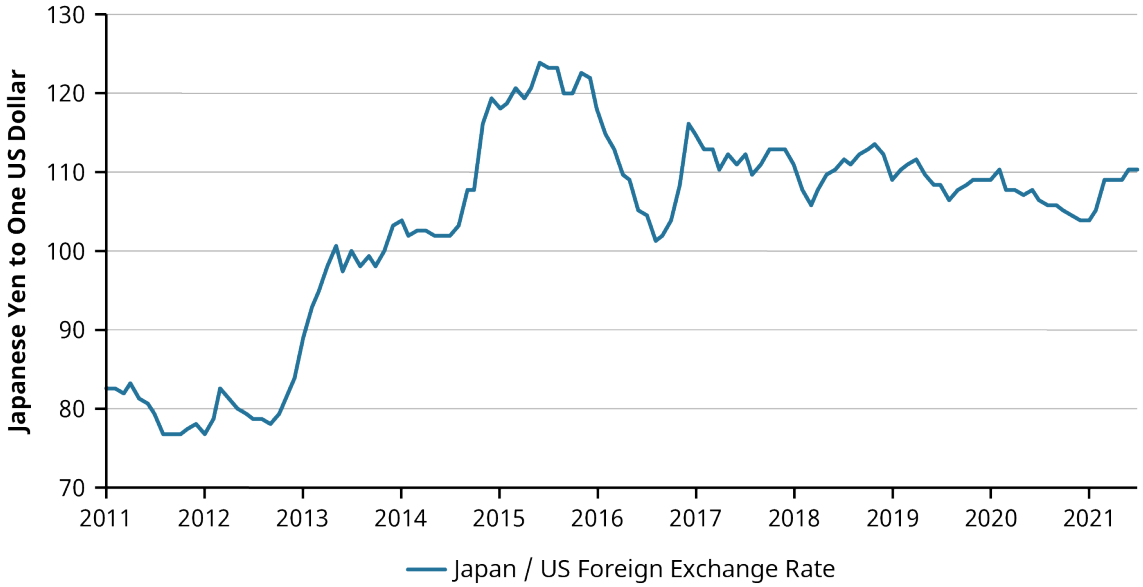



**Figure 20.3 Japanese Yen to One US Dollar**[8]

If a company is receiving yen from customers and paying expenses in dollars, the company is harmed when the yen depreciates relative to the dollar, meaning that the yen the company receives from its customers can be exchanged for fewer dollars. Conversely, when the yen appreciates, it takes fewer yen to purchase each dollar; this appreciation of the yen benefits companies with revenues in yen and expenses in dollars.

## THINK IT THROUGH

### Projecting Sales in US Dollars

The managers of a firm think that the exchange rate of Japanese yen to US dollars will be $\text{JPY } 100 = \text{USD } 1$ next year. If the company thinks that it will have sales of 50 million yen next year, how much will it project these sales will be worth in dollars? What happens if the actual exchange rate over the next year is $\text{JPY } 120 = \text{USD } 1$?

**Solution:**

An exchange rate of $\text{JPY } 100 = \text{USD } 1$ implies that $\text{JPY } 1 = \text{USD } 0.0100$. If the company expects to have sales of JPY 50,000,000, it is expecting sales to be worth USD 500,000. If the exchange rate is really $\text{JPY } 120 = \text{USD } 1$, this is the same as $\text{JPY } 1 = \text{USD } 0.0083$. With this exchange rate, JPY 50,000,000 in sales would be equivalent to USD 415,000. The company would receive $85,000 less from these sales in Japan than it was expecting, even if it met its goals as far as the number of units of items sold.

8 Data from Board of Governors of the Federal Reserve System (US). "Japan / US Foreign Exchange Rate (DEXJPUS)." FRED. Federal Reserve Bank of St. Louis, accessed August 6, 2021. https://fred.stlouisfed.org/series/DEXJPUS

### Translation Risk

In addition to the transaction risk, if Starbucks holds assets in a foreign country, it faces **translation risk**. Translation risk is an accounting risk. Starbucks might purchase a coffee plantation in Costa Rica for 120 million Costa Rican colones. This land is an asset for Starbucks, and as such, the value of it should appear on the company's balance sheet.

The balance sheet for Starbucks is created using US dollar values. Thus, the value of the coffee plantation has to be translated to dollars. Because exchange rates are volatile, the dollar value of the asset will vary depending on the day on which the translation takes place. If the exchange rate is 500 colones to the dollar, then this coffee plantation is an asset with a value of $240,000. If the Costa Rican colón depreciates to 600 colones to the dollar, then the asset has a value of only $200,000 when translated using this exchange rate.

Although it is the same piece of land with the same productive capacity, the value of the asset, as reported on the balance sheet, falls as the Costa Rican colón depreciates. This decrease in the value of the company's assets must be offset by a decrease in the stockholders' equity for the balance sheet to balance. The loss is due simply to changes in exchange rates and not the underlying profitability of the company.

### Economic Risk

**Economic risk** is the risk that a change in exchange rates will impact a business's number of customers or its sales. Even a company that is not involved in international transactions can face this type of risk. Consider a company located in Mississippi that makes shirts using 100% US-grown cotton. All of the shirts are made in the United States and sold to retail outlets in the United States. Thus, all of the company's expenses and revenues are in US dollars, and the company holds no assets outside of the United States.

Although this firm has no financial transactions involving international currency, it can be impacted by changes in exchange rates. Suppose the US dollar strengthens relative to the Vietnamese dong. This will allow US retail outlets to purchase more Vietnamese dong, and thus more shirts from Vietnamese suppliers, for the same amount of US dollars. Because of this, the retail outlets experience a drop in the cost of procuring the Vietnamese shirts relative to the shirts produced by the firm in Mississippi. The Mississippi company will lose some of its customers to these Vietnamese producers simply because of a change in the exchange rate.

## Hedging

Just as companies may practice hedging techniques to reduce their commodity risk exposure, they may choose to hedge to reduce their currency risk exposure. The types of futures contracts that we discussed earlier in this chapter exist for currencies as well as for commodities. A company that knows that it will need Korean won later this year to purchase raw materials from a South Korean supplier, for example, can purchase a futures contract for Korean won.

While futures contracts allow companies to lock in prices today for a future commitment, these contracts are not flexible enough to meet the risk management needs of all companies. Futures contracts are standardized contracts. This means that the contracts have set sizes and maturity dates. Futures contracts for Korean won, for example, have a contract size of 125 million won. A company that needs 200 million won later this year would need to either purchase one futures contract, hedging only a portion of its needs, or purchase two futures contracts, hedging more than it needs. Either way, the company has remaining currency risk.

In this next section, we will explore some additional hedging techniques.

### Forward Contracts

Suppose a company needs access to 200 million Korean won on March 1. In addition to a specified contract size, currency futures contracts have specified days on which the contracts are settled. For most currency futures contracts, this occurs on the third Wednesday of the month. If the company needed 125 million Korean won (the basic contract size) on the third Wednesday of March (the standard settlement date), the futures

contract could be useful. Because the company needs a different number of Korean won on a different date from those specified in the standard contract, the futures contract is not going to meet the specific risk management needs of the company.

Another type of contract, the **forward contract**, can be used by this company to meet its specific needs. A forward contract is simply a contractual agreement between two parties to exchange a specified amount of currencies at a future date. A company can approach its bank, for example, saying that it will need to purchase 200 million Korean won on March 1. The bank will quote a forward rate, which is a rate specified today for the sale of currency on a future date, and the company and the bank can enter into a forward contract to exchange dollars for 200 million Korean won at the quoted rate on March 1.

Because a forward contract is a contract between two parties, those two parties can specify the amount that will be traded and the date the trade will occur. This contract is similar to your agreeing with a hotel that you will arrive on March 1 and rent a room for three nights at $200 per night. You are agreeing today to show up at the hotel on a future (specified) date and pay the quoted price when you arrive. The hotel agrees to provide you the room on March 1 and cannot change the price of the room when you arrive. With a forward contract, you are also agreeing that you will indeed make the purchase and you cannot change your mind; so, using the hotel room analogy, this would mean that the hotel will definitely charge your credit card for the agreed-upon $200 per night on March 1.

The forward contract is an individualized contract between the buyer and the seller; they are both under a contractual obligation to honor the contract. Because this contract is not standardized like the futures contract (so that it can be traded on an exchange), it can be tailored to the needs of the two parties. While the forward contract has the advantage of being fine-tuned to meet the company's needs, it has a risk, known as *counterparty risk*, that the futures contract does not have. The forward contract is only as good as the promise of the counterparty. If the company enters into a forward contract to purchase 200 million Korean won on March 1 from its bank and the bank goes out of business before March 1, the company will not be able to make the exchange with a nonexistent bank. The exchanges on which futures contracts are traded guard the purchaser of a futures contract from this type of risk by guaranteeing the contract.

## Natural Hedges

A hedge simply refers to a reduction in the risk or exposure that a company has to volatility and uncertainty. We have been focusing on how a company might use financial market instruments to hedge, but sometimes a company can use a **natural hedge** to mitigate risk. A natural hedge occurs when a business can offset its risk simply through its own operations. With a natural hedge, when a risk occurs that would decrease the value of a company, an offsetting event occurs within the firm that increases the value of the company.

As an example, consider a British-based travel agency. One of the major tours the company offers is a tour of Italy. The company arranges for transportation, lodging, meals, and sightseeing for Brits to visit the highlights of Rome, Florence, and Venice. Because the company charges customers in British pounds but must pay the bus companies, hotels, and other service providers in Italy in euros, the travel agency faces significant transaction exposure. If the value of the British pound depreciates after the company sets the price it will charge for the tour but before it pays the Italian suppliers, the company will be harmed. In fact, if the British pound depreciates by a great deal, the company could end up in a situation in which the British pounds it collects are not enough to purchase the euros it needs to pay its suppliers.

The company could create a natural hedge by offering tours of London to individuals living in the European Union. The travel agency could charge people who live in Germany, Italy, Spain, or any other country that has the euro as its currency for a travel package to London. Then the agency would pay British restaurants, tour guides, hotels, and bus companies in British pounds. This segment of the business also has currency risk. If the British pound depreciates, the company gains because the euros it collects from its EU customers will purchase more British pounds than before.

Thus, the company has created a situation in which if the British pound depreciates, the decrease in value of its tours of Italy is exactly offset by the increase in value of its tours of London. If the British pound appreciates, the opposite occurs: the company experiences a gain in its division that charges British pounds for tourists traveling to Italy and an offsetting loss in its division that charges euros for tourists traveling to London.

## Options

A financial **option** gives the owner the right, but not the obligation, to purchase or sell an asset for a specified price at some future date. Options are considered **derivative** securities because the value of a derivative is derived from, or comes from, the value of another asset.

## Options Terminology

Specific terminology is used in the finance industry to describe the details of an options contract. If the owner of an option decides to purchase or sell the asset according to the terms of the options contract, the owner is said to be **exercising** the option. The price the option holder pays if purchasing the asset or receives if selling the asset is known as the *strike price* or *exercise price*. The price the owner of the option paid for the option is known as the *premium*.

An option contract will have an **expiration date**. The most common kinds of options are **American options**, which allow the holder to exercise the option at any time up to and including the expiration date. Holders of **European options** may exercise their options only on the expiration date. The labels *American option* and *European option* can be confusing as they have nothing to do with the location where the options are traded. Both American and European options are traded worldwide.

Option contracts are written for a variety of assets. The most common option contracts are options on shares of stock. Options are traded for US Treasury securities, currencies, gold, and oil. There are also options on agricultural products such as wheat, soybeans, cotton, and orange juice. Thus, options can be used by financial managers to hedge many types of risk, including currency risk, interest rate risk, and the risk that arises from fluctuations in the prices of raw materials.

Options are divided into two main categories, call options and put options. A **call option** gives the owner of the option the right, but not the obligation, to buy the underlying asset. A **put option** gives the owner the right, but not the obligation, to sell the underlying asset.

## Call Options

If a Korean company knows that it will need pay a $100,000 bill to a US supplier in six months, it knows how many US dollars it will need to pay the bill. As a Korean company, however, its bank account is denominated in Korean won. In six months, it will need to use its Korean won to purchase 100,000 US dollars.

The company can determine how many Korean won it would take to purchase $100,000 today. If the current exchange rate is $\text{KWN } 1{,}100 = \text{USD } 1$, then it will need KWN 110,000,000 to pay the bill. The current exchange rate is known as the **spot rate**.

The company, however, does not need the US dollars for another six months. The company can purchase a call option, which is a contract that will allow it to purchase the needed US dollars in six months at a price stated in the contract. This allows the company to guarantee a price for dollars in six months, but it does not obligate the company to purchase the dollars at that price if it can find a better price when it needs the dollars in six months.

The price that is in the contract is called the **strike price (exercise price)**. Suppose the company purchases a call contract for US dollars with a strike price of KWN 1,200/USD. While this contract would be for a set size, or a certain number of US dollars, we will talk about this transaction as if it were per one US dollar to highlight how options contracts work.

The company must pay a price, known as the **premium**, to purchase this call option contract. For our example, let's assume the premium for the call option contract is KWN 50. In other words, the company has paid KWN 50 for the right to buy US dollars in six months for a price of KWN 1,200/USD.

In six months, the company makes a choice to either (1) pay the strike price of KWN 1,200/USD or (2) let the option expire. If the company chooses to pay the strike price and purchase the US dollars, it is exercising the option. How does the company choose which to do? It simply compares the strike price of KWN 1,200/USD to the market, or spot, exchange rate at the time the option is expiring.

If, six months from now, the spot exchange rate is $\text{KWN } 1{,}150 = \text{USD } 1$, it will be cheaper for the company to buy the US dollars it needs at the spot price than it would be to buy the dollars with the option. In fact, if the spot rate is anything below $\text{KWN } 1{,}200 = \text{USD } 1$, the company will not choose to exercise the option. If, however, the spot exchange rate in six months is $\text{KWN } 1{,}300 = \text{USD } 1$, the company will exercise the option and purchase each US dollar for only KWN 1,200.

The profitability, or the payoff, to the owner of a call option is represented by the chart in Figure 20.4 below. Possible spot prices are measured from left to right, and the financial gain or loss to the company of the option contract is measured vertically. If the spot price is anything less than KWN 1,200/USD, the option expires without being exercised. The company paid KWN 50 for something that ended up being worthless.

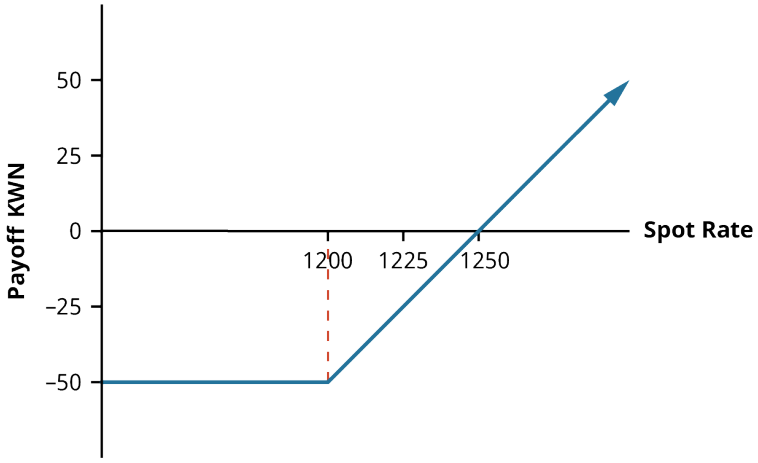



**Figure 20.4 The Payoff to the Holder of a Call Option**

If, in six months, the spot exchange rate is $\text{KWN } 1{,}225 = \text{USD } 1$, then the company will choose to exercise the option. The company will be saving KWN 25 for each dollar purchased, but the company originally paid 50 KWN for the contract. So, the company will be 25 KWN worse off than if it had never purchased the call option.

If the spot exchange rate is $\text{KWN } 1{,}250 = \text{USD } 1$, the company will be in exactly the same position having purchased and exercised the call option as it would have been if it had not purchased the option. At any spot price higher than KWN 1,250/USD, the firm will be in a better financial position, or will have a positive payoff, because it purchased the call option. The more the Korean won depreciates over the next six months, the higher the payoff to the firm of owning the call contract. Purchasing the call contract is a way that the company can protect itself from the currency exposure it faces.

For any transaction, there must be two parties—a buyer and a seller. For the company to have purchased the call option, another party must have sold the call option. The seller of a call option is called the **option writer**. Let's consider the potential benefits and risks to the writer of the call option.

When the company purchases the call option, it pays the premium to the writer. The writer of the option does not have a choice regarding whether the option will be exercised. The purchaser of the option has the right to make the choice; in essence, the writer of the option sold the right to make that decision to the purchasers of the call option.

Figure 20.5 shows the payoff to the writer of the call option. Recall that the buyer of the call option will let the option expire if the spot rate is less than $\text{KWN } 1{,}200 = \text{USD } 1$ when the call option matures in six months. If this occurs, the writer of the option collected the KWN 50 option premium when the contract was sold and then never hears from the purchaser again. This is what the writer of the option is hoping for; the writer of the call option profits when the options contract is not exercised

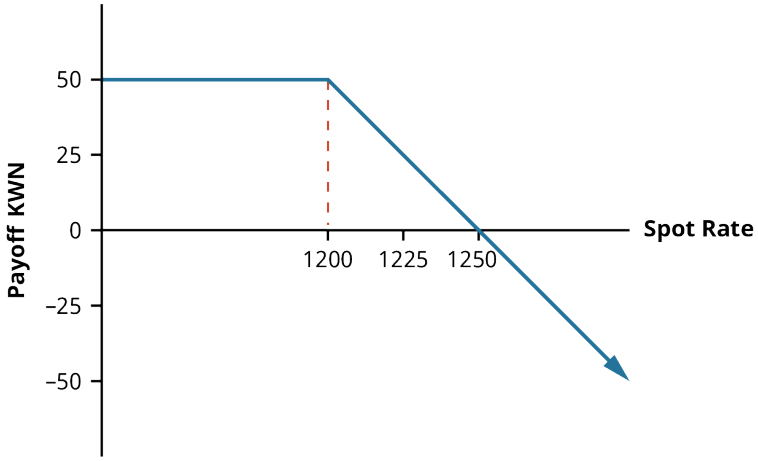



**Figure 20.5 The Payoff to the Writer of a Call Option**

If the spot rate is above $\text{KWN } 1{,}200 = \text{USD } 1$, then the holder of the option will choose to exercise the right to purchase the won at the option strike price. Then the writer of the option will be obligated to sell the Korean won at a price of KWN 1,200/USD. If the spot rate is $\text{KWN } 1{,}250 = \text{USD } 1$, the option writer will be obligated to sell the dollars for KWN 50 less than what they are worth; because the option writer was initially paid a KWN 50 premium for taking on that obligation, the option writer will just break even. For any exchange rate higher than $\text{KWN } 1{,}250 = \text{USD } 1$, the writer of the call option will have a loss.

The option contract is a zero-sum game. Any payoff the owner of the option receives is exactly equal to the loss the writer of the option has. Any loss the owner of the option has is exactly equal to the payoff the writer of the option receives.

## Put Options

While the call option you just considered gives the owner the right to buy an underlying asset, the put option gives the owner to right to sell an underlying asset. Take, for example, an Indian company that has a contract to provide graphic artwork for a US company. The US company will pay the Indian company 200,000 US dollars in three months.

While the Indian company receives US dollars, it must pay its workers in Indian rupees. Because the company does not know what the spot exchange rate will be in three months, it faces transaction risk and may be interested in hedging this exposure using a put option.

The company knows that the current spot rate is $\text{INR } 75 = \text{USD } 1$, meaning that the company would be able to use $200,000 to purchase $\text{USD } 200{,}000 \times \frac{\text{INR } 75}{\text{USD}} = \text{INR } 15{,}000{,}000$ if it possessed the $200,000 today. If the Indian rupee appreciates relative to the US dollar over the next three months, however, the company will receive fewer rupees when it makes the exchange; perhaps the company will not be able to purchase enough rupees to cover the wages of its employees.

Assume the company can purchase a put option that gives it the right to sell US dollars in three months at a strike price of INR 75/USD; the premium for this put option is INR 5. By purchasing this put option, the company is spending INR 5 to guarantee that it can sell its US dollars for rupees in three months at a price of INR 75/USD.

If, in three months, when the company receives payment in US dollars, the spot exchange rate is higher than

$\text{INR } 75 = \text{USD } 1$, the company will simply exchange the US dollars for rupees at that exchange rate, allowing the put option to expire without exercising it. The payoff to the company for the option is INR -5, the premium that was paid for the option that was never used (see Figure 20.6).

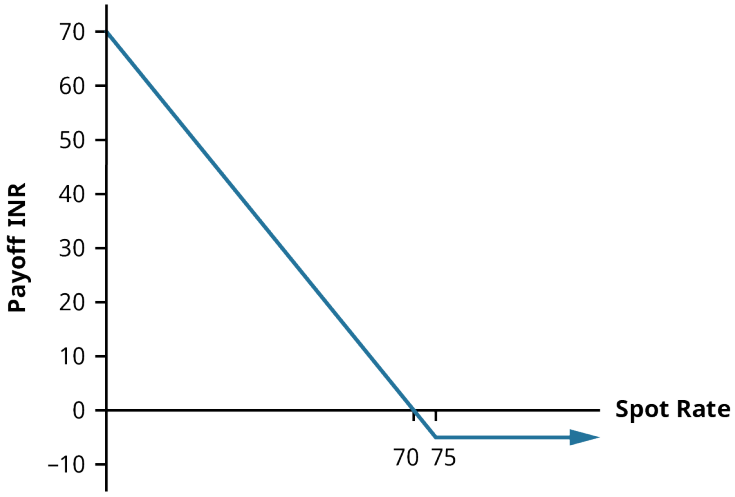



**Figure 20.6 The Payoff to the Holder of a Put Option**

If, however, in three months, the spot exchange rate is anything less than $\text{INR } 75 = \text{USD } 1$, then the company will choose to exercise the option. If the spot rate is between $\text{INR } 70 = \text{USD } 1$ and $\text{INR } 75 = \text{USD } 1$, the payoff for the option is negative. For example, if the spot exchange rate is $\text{INR } 72 = \text{USD } 1$, the company will exercise the option and receive three more Indian rupees per dollar than it would in the spot market. However, the company had to spend INR 5 for the option, so the payoff is INR -2. At a spot exchange rate of $\text{INR } 70 = \text{USD } 1$, the company has a zero payoff; the benefit of exercising the option, INR 5, is exactly equal to the price of purchasing the option, the premium of INR 5.

If, in three months, the spot exchange rate is anything below $\text{INR } 70 = \text{USD } 1$, the payoff of the put option is positive. At the theoretical extreme, if the USD became worthless and would purchase no rupees in the spot market when the company received the dollars, the company could exercise its option and receive INR 75/USD, and its payoff would be INR 70.

Now that we have considered the payoff to a purchaser of a put contract, let's consider the opposite side of the contract: the seller, or writer, of the put option. The writer of a put option is selling the right to sell dollars to the purchaser of the put option. The writer of the put option collects a premium for this. The writer of the put has no choice as to whether the put option will be exercised; the writer only has an obligation to honor the contract if the owner of the put option chooses to exercise it.

The owner of the option will choose to let the option expire if the spot exchange rate is anything above $\text{INR } 75 = \text{USD } 1$. If that is the case, the writer of the put option collects the INR 5 premium for writing the put, as shown by the horizontal line in Figure 20.7. This is what the writer of the put is hoping will occur.

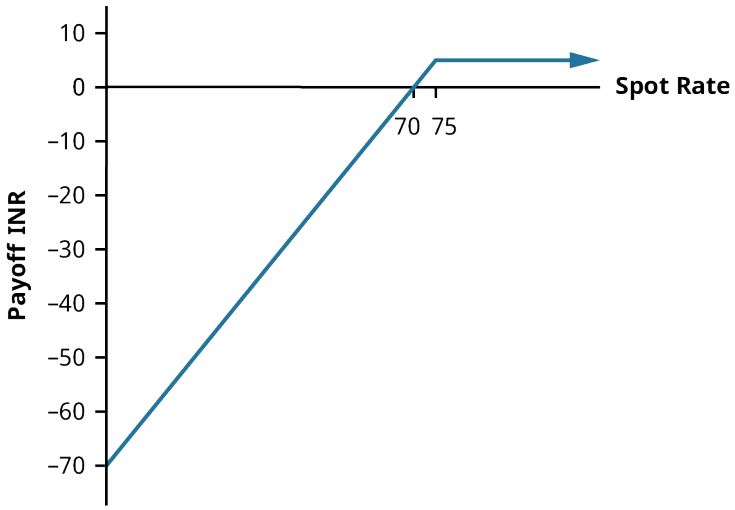



**Figure 20.7 The Payoff to the Writer of a Put Option**

The owner of the option will choose to exercise the option if the exchange rate is less than $\text{INR } 75 = \text{USD } 1$. If the spot exchange rate is between $\text{INR } 70 = \text{USD } 1$ and $\text{INR } 75 = \text{USD } 1$, the writer of the put option has a positive payoff. Although the writer must now purchase US dollars for a price higher than what the dollars are worth, the INR 5 premium that the writer received when entering into the position is more than enough to offset that loss.

If the spot exchange rate drops below $\text{INR } 70 = \text{USD } 1$, however, the writer of the put option is losing more than INR 5 when the option is exercised, leaving the writer with a negative payoff. In the extreme, the writer of the put will have to purchase worthless US dollars for INR 75/USD, resulting in a loss of INR 70.

Notice that the payoff to the writer of the put is the negative of the payoff to the holder of the put at every spot price. The highest payoff occurs to the writer of the put when the option is never exercised. In that instance, the payoff to the writer is the premium that the holder of the put paid when purchasing the option (see Figure 20.7).

Table 20.2 provides a summary of the positions that the parties who enter into options contract are in. Remember that the buyer of an option is always the one purchasing the right to do something. The seller or writer of an option is selling the right to make a decision; the seller has the obligation to fulfill the contract should the buyer of the option choose to exercise the option. The most the seller of an option can ever profit is by the premium that was paid for the option; this occurs when the option is not exercised.

| | | | Benefits | | Harm | |
|---|---|---|---|---|---|---|
| **Party to an Option Contract** | **Right of the Party** | **Obligation of the Party** | **When** | **Maximum Profit** | **When** | **Maximum Loss** |
| Buyer of a call | To buy | | Price of underlying rises | Unlimited | Price of underlying falls | Premium paid |
| Seller of a call | | To sell | Price of underlying falls | Premium received | Price of underlying rises | Unlimited |

**Table 20.2 Summary of Option Contracts**

| | | | Benefits | | Harm | |
|---|---|---|---|---|---|---|
| Party to an Option Contract | Right of the Party | Obligation of the Party | When | Maximum Profit | When | Maximum Loss |
| Buyer of a put | To sell | | Price of underlying falls | Strike price minus premium | Price of underlying rises | Premium paid |
| Seller of a put | | To buy | Price of underlying rises | Premium received | Price of underlying falls | Strike price minus premium |

**Table 20.2 Summary of Option Contracts**

# 20.4 Interest Rate Risk

## Learning Outcomes

By the end of this section, you will be able to:

- Describe interest rate risk.
- Explain how a change in interest rates changes the value of cash flows.
- Describe the use of an interest rate swap.

An interest rate is simply the price of borrowing money. Just as other prices are volatile, interest rates are also volatile. Just as volatility in other prices leads to uncertain cash flows for a company, volatility in interest rates can also lead to uncertain cash flows.

## Measuring Interest Rate Risk

Suppose that a company is supposed to pay a bill of $1,000 in 10 years. The present value of this bill depends on the level of interest rates. If the interest rate is 5%, the present value of the bill is $\frac{\$1{,}000}{(1+0.05)^{10}} = \$613.91$. If the interest rate rises to 6%, the present value of the bill is $\frac{\$1{,}000}{(1+0.06)^{10}} = \$558.39$. The increase in the interest rate by 1% causes the present value of the expected cash flow to fall by $\frac{613.91 - 558.39}{613.91} = 0.0904 = 9.04\%$.

Interest rate risk can be highlighted by looking at bonds. Consider two $1,000 face value bonds with a 5% coupon rate, paid semiannually. One of the bonds matures in five years, and the other bond matures in 30 years. If the market interest rate is 5%, each of these bonds will sell for face value, or $1,000. If, instead, the market interest rate is 6%, the five-year bond will sell for $957.35 and the 30-year bond will sell for $861.62.

Notice that as the interest rate rises, the price of both of these bonds will fall. However, the price of the longer-term bond will fall by more than the price of the shorter-term bond. The longer-term bond price will fall by 1.38%; the shorter-term bond price will fall by only 0.43%.

Consider two additional $1,000 face value bonds. The difference is that these bonds have a 6% coupon rate, paid semiannually. If a bond has a 6% coupon rate and matures in five years, it will sell for $1,043.76 when the market interest rate is 5%. A 30-year bond that matures in 30 years and has a 6% coupon rate will sell for $1,154.54 when the market interest rate is 5%. However, if the interest rate in the economy is 6%, both of these bonds will sell for a price of $1,000. The price of the five-year bond will drop by 4.19%; the price of the 30-year bond will drop by 13.39%.

## THINK IT THROUGH

### Calculating Bond Prices as the Interest Rates Changes

You are considering purchasing a $10,000 face value bond with a 4% coupon rate, paid semiannually, that matures in 20 years. If you require a 5% return to purchase this bond, what is the maximum price you would be willing to pay for the bond? If, instead, you require an 8% return to purchase this bond, what is the maximum price you would be willing to pay for the bond?

**Solution:**

If the bond pays coupon interest semiannually, you will receive one-half of the face value of the bond multiplied by the coupon rate every six months. So, you will receive 40 coupon payments of $\$10{,}000 \times 0.02 = \$200$. At maturity, you will receive one lump sum of the face value of the bond. Follow the steps in Table 20.3 to calculate the price of the bond if you require a 5% return, using a financial calculator.

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 1 | Enter the number of coupon payments you will receive | 40 N | N = | 40 |
| 2 | Enter your semiannual required return | 2.5 I/Y | I/Y = | 2.5 |
| 3 | Enter the semiannual coupon payment | 200 PMT | PMT = | 200 |
| 4 | Enter the face value of the bond | 10000 FV | FV = | 10,000 |
| 5 | Calculate the present value | CPT PV | PV = | -8,744.86 |

**Table 20.3 Calculator Step to Price a Bond Requiring a 5% Return**[9]

When your required yield is 5%, the most you would be willing to pay for this bond is $8,744.86.

To calculate the price of the bond if your required return is 8%, use the same process, replacing the I/YR in step 2 with 4 (see Table 20.4). All other variables remain the same because the characteristics of the bond have not changed.

| Step | Description | Enter | Display | |
|---|---|---|---|---|
| 1 | Enter the number of coupon payments you will receive | 40 N | N = | 40 |
| 2 | Enter your semiannual required return | 4 I/Y | I/Y = | 4 |
| 3 | Enter the semiannual coupon payment | 200 PMT | PMT = | 200 |
| 4 | Enter the face value of the bond | 10000 FV | FV = | 10,000 |
| 5 | Calculate the present value | CPT PV | PV = | -6,041.45 |

**Table 20.4 Calculator Steps to Price a Bond Requiring an 8% Return**

If your required return is 8% to invest in this bond, you will be willing to pay only $6,041.45 to purchase the bond.

Thus, if interest rates rise because of changing market conditions, the price of bonds will fall.

The sensitivity of bond prices to changes in the interest rate is known as interest rate risk. **Duration** is an

9 The specific financial calculator in these examples is the Texas Instruments BA II Plus™ Professional model, but you can use other financial calculators for these types of calculations.

important measure of interest rate risk that incorporates the maturity and coupon rate of a bond as well as the level of current market interest rates. Calculating duration is a complex topic that is beyond the scope of this introductory textbook, but it is useful to note that

- the higher the duration of a bond, the more sensitive the price of the bond will be to interest rate changes;
- the duration of a bond will be higher when market yields are lower, all else being equal;
- the duration of a bond will be higher the longer the maturity of the bond, all else being equal; and
- the duration of a bond will be higher the lower the coupon rate on the bond, all else being equal.

## Swap-Based Hedging

As the name suggests, a **swap** involves two parties agreeing to swap, or exchange, something. Generally, the two parties, known as counterparties, are swapping obligations to make specified payment streams.

To illustrate the basics of how an interest rate swap works, let's consider two hypothetical companies, Alpha and Beta. Alpha is a strong, well-established company with a AAA (triple-A) bond rating. This means that Alpha has the highest rating a company can have. With this high rating, Alpha can borrow at relatively low interest rates. Often, companies in this situation will borrow at a floating rate. This means that their interest rate goes up and down as interest rates in the overall economy vary. The floating rate will be tied to a benchmark rate that is widely quoted in the financial press. Historically, companies have often used the London Interbank Offered Rate (LIBOR) as the benchmark rate. Because published quotes for LIBOR will be phased out by 2023, firms are beginning to use alternative rates. As of yet, no single alternative has emerged as the most commonly used rate; therefore, LIBOR will be used in our example. Suppose that Alpha finds that it can borrow money at rate equal to $\text{LIBOR} + 0.25\%$; thus, if LIBOR is 2.75%, the company will pay 3.0% to borrow. If the company wants to borrow at a long-term fixed rate, its cost of borrowing will be 5.0%.

### LINK TO LEARNING

#### LIBOR Transition

Although the basic principles of financial transactions remain the same over time, the particular financial instruments used change from time to time. Innovation, regulation, and technological advances lead to these changes in financial instruments. The use of LIBOR as a benchmark rate is winding down in the early 2020s. To find out more about this transition and how it impacts companies, visit the About LIBOR Transition (https://openstax.org/r/About_LIBOR_Transition) website.

Beta has a BBB bond rating. Although this is considered a good, investment-grade rating, it is lower than the rating of Alpha. Because Beta is less creditworthy and a bit riskier than Alpha, it will have to pay a higher interest rate to borrow money. If Beta wants to borrow money at a floating rate, it will need to pay $\text{LIBOR} + 0.75\%$. If LIBOR is 2.75%, Beta must pay 3.5% on its floating rate debt. In order for Beta to borrow at a long-term fixed rate, its cost of borrowing will be 6.75%.

Let's consider how these two companies can enter into a swap in which both parties benefit. Table 20.5 summarizes the situation and the rates at which Alpha and Beta can borrow. It also illustrates a way in which an interest rate swap can benefit both Alpha and Beta.

| | Alpha | Beta |
|---|---|---|
| Bond rating | AAA | BBB |
| Floating rate | $\text{LIBOR} + 0.25$ | $\text{LIBOR} + 0.75$ |
| Fixed rate | 5 | 6.75 |

**Table 20.5 Example of a Swap Agreement**

| | Alpha | Beta |
|---|---|---|
| Rate company chooses | Fixed at 5.0 | Floating at $\text{LIBOR} + 0.75$ |
| Swap | N/A | N/A |
| Beta pays Alpha fixed rate | 5.5 | -5.5 |
| Alpha pays Beta floating rate | -LIBOR | +LIBOR |
| Payments and receipts | $-5.0 + 5.5 - \text{LIBOR}$ | $-(\text{LIBOR} + 0.75) - 5.5 + \text{LIBOR}$ |
| Net amount | $0.5 - \text{LIBOR}$ | -6.25 |
| Benefit | 0.75 | 0.5 |

**Table 20.5 Example of a Swap Agreement**

Alpha borrows in the capital markets at a fixed rate of 5%. Beta chooses to borrow at a floating rate that equals $\text{LIBOR} + 0.75\%$. Beta also agrees to pay Alpha a fixed rate of 5.5%. In essence, Beta is paying 5.5% to Alpha, 0.75% to its lender, and LIBOR to its lender.

In return, Alpha promises to pay Beta LIBOR. The exact amount that Alpha will pay to Beta fluctuates as LIBOR fluctuates. However, from Beta's perspective, the payment of LIBOR it receives from Alpha exactly offsets the payment of LIBOR it makes to its lender. When LIBOR increases, the rate of $\text{LIBOR} + 0.75\%$ that Beta is paying to its lender increases, but the LIBOR rate it receives from Alpha also increases. When LIBOR decreases, Beta receives less from Alpha, but it also pays less to its lender. Because the LIBOR it receives from Alpha is exactly equal to the LIBOR it pays to its lender, Beta's net amount of interest paid is 6.25%—the 5.5% it pays to Alpha plus the 0.75% it pays to its lender.

Alpha is in the position of paying 5.0% to its lender and LIBOR to Beta while receiving 5.5% from Beta. This means that Alpha's net interest paid is $\text{LIBOR} - 0.5\%$. Alpha is said to have swapped its fixed interest rate for a floating rate. Because it is paying $\text{LIBOR} - 0.5\%$, it will experience fluctuating interest rates; however, as a company with a AAA bond rating, it is a strong, creditworthy company that can withstand that interest rate exposure. It would have cost Alpha $\text{LIBOR} + 0.25\%$ to borrow the money from its lenders at a variable rate. By participating in this swap arrangement, Alpha has been able to lower its interest rate by 0.75%.

Through this swap arrangement, Beta has been able to fix its interest rate at 6.25% rather than having a variable rate. This predictability is a benefit for a company, especially one that is in a bit more precarious position as far as its creditworthiness and stability. The 6.25% Beta pays as a result of this arrangement is 0.5% below the 6.75% it would have paid if it simply borrowed from its lenders at a fixed rate.

# Summary

## 20.1 The Importance of Risk Management

Risk arises due to uncertainty. The future is unpredictable. One job of the financial manager is to manage the risks of both cash inflows and cash outflows. Investors are risk-averse. The riskier a firm's cash flows are, the higher the rate of return investors require to provide capital to the company.

## 20.2 Commodity Price Risk

Companies do not know how much they will have to pay for raw materials in future months. The price of raw materials will change as economic conditions change, impacting a company's cost of goods sold and profits. Some ways that a company can hedge this risk are through vertical integration, long-term contracts, and futures contracts.

## 20.3 Exchange Rates and Risk

Exchange rates are unpredictable. This leads to transaction risk, translation risk, and economic risk as currency values change. A forward contract is an agreement between two parties to make an exchange at a particular rate on a given date in the future. Companies can use options to mitigate the risks. A call option gives the holder the right, but not the obligation, to purchase an underlying asset. A put option give the holder the right, but not the obligation, to sell an underlying asset.

## 20.4 Interest Rate Risk

When interest rates increase, the present value of future cash flows decreases. Duration is a measure of interest rate risk. A swap involves two parties agreeing to exchange something, often specified payment streams.

# Key Terms

**American option** an option that the holder can exercise at any time up to and including the exercise date
**appreciate** when one unit of a currency will purchase more of a foreign currency than it did previously
**call option** an option that gives the owner the right, but not the obligation, to buy the underlying asset at a specified price on some future date
**depreciate** when one unit of a currency will purchase less of a foreign currency than it did previously
**derivative** a security that derives its value from another asset
**duration** a measure of interest rate risk
**economic risk** the risk that a change in exchange rates will impact the number of customers a business has or its sales
**European option** an option that the holder can exercise only on the expiration date
**exchange rate** the price of one currency in terms of another currency
**exercise price (strike price)** the price the option holder pays for the underlying asset when exercising an option
**exercising** choosing to purchase or sell the asset underlying a held option according to the terms of the option contract
**expiration date** the date an option contract expires
**forward contract** a contractual agreement between two parties to exchange a specified amount of assets on a specified future date
**futures contract** a standardized contract to trade an asset on some future date at a price locked in today
**hedging** taking an action to reduce exposure to a risk
**margin** the collateral that must be posted to guarantee that a trader will honor a futures contract
**marking to market** a procedure by which cash flows are exchanged daily for a futures contract, rather than at the end of the contract

**natural hedge** when a company offsets the risk that something will decrease in value by having a company activity that would increase in value at the same time
**option** an agreement that gives the owner the right, but not the obligation, to purchase or sell an asset at a specified price on some future date
**option writer** seller of a call or put option
**premium** the price a buyer of an option pays for the option contract
**put option** an option that gives the owner the right, but not the obligation, to sell the underlying asset at a specified price on some future date
**speculating** attempting to profit by betting on the uncertain future, knowing that a risk of loss is involved
**spot rate** the current market exchange rate
**strike price (exercise price)** the price an option holder pays for the underlying asset when exercising the option
**swap** an agreement between two parties to exchange something, such as their obligations to make specified payment streams
**transaction risk** the risk that a change in exchange rates will impact the value of a business's expected receipts or expenses
**translation risk** the risk that a change in exchange rates will impact the value of items on a company's financial statements
**vertical integration** the merger of a company with its supplier

## CFA Institute

This chapter supports some of the Learning Outcome Statements (LOS) in this CFA® Level I Study Session (https://openstax.org/r/cfa-institute-Level-I-Study-Session). Reference with permission of CFA Institute.

## Multiple Choice

1. Which of the following does a financial manager want to do to maximize the value of the firm?
   **a.** Decrease the speed of money coming into the firm
   **b.** Speed up cash going out and slow down cash coming in
   **c.** Decrease the riskiness of cash inflows and cash outflows
   **d.** Increase the volatility and speed of cash going out of the firm

2. In finance, risk is _____.
   **a.** the same thing as profit
   **b.** ignored because it is inevitable
   **c.** thought of as uncertainty or unpredictability
   **d.** something that financial managers should strive to increase and maximize

3. American Jeans Corp. purchases a cotton farm. The cotton grown on the farm will be used to make denim cloth for the company's jeans. This is an example of _____.
   **a.** striking a price
   **b.** vertical integration
   **c.** a forward contract
   **d.** an American option

4. The price that a holder of an option pays to buy the underlying asset when exercising a call option is known as _____.
   **a.** the strike price
   **b.** the maturity price
   **c.** the exchange price
   **d.** the underlying premium

5. Which of the following gives the holder the right, but not the obligation, to purchase an underlying asset?
   a. A call option
   b. A forward contract
   c. A European put option
   d. An American put option

6. An American option allows the holder to _____.
   a. exercise the option only on the expiration date
   b. exercise the option at any time up to and including the expiration date
   c. sell stocks, and a European option allows the holder to purchase stocks
   d. purchase stocks, and a European option allows the holder to purchase bonds

7. The holder of a(n) _____ has the right to buy and the holder of a(n) _____ has the right to sell an underlying asset.
   a. call option; put option
   b. put option; call option
   c. American option; European option
   d. European option; American option

8. The three main categories of foreign exchange risk a company faces are _____.
   a. economic risk, business risk, and exposure risk
   b. exposure risk, fluctuation risk, and forward risk
   c. transaction risk, translation risk, and economic risk
   d. appreciation risk, depreciation risk, and duplication risk

9. In January, the exchange rate between the South Korean won and the US dollar was $\text{KWN } 1,100 = \text{USD } 1$. Three months later, the exchange rate was $\text{KWN } 1,200 = \text{USD } 1$. This means that _____.
   a. the Korean won appreciated relative to the US dollar
   b. the Korean won depreciated relative to the US dollar
   c. the US dollar depreciated relative to the Korean won
   d. both the Korean won and the US dollar appreciated

10. In January, the exchange rate between the South Korean won and the US dollar was $\text{KWN } 1,100 = \text{USD } 1$. Three months later, the exchange rate was $\text{KWN } 1,200 = \text{USD } 1$. This means that _____.
    a. it will cost US companies more to purchase raw materials from South Korea
    b. it will cost Korean companies more to purchase raw materials from the United States
    c. US companies that sell their products in South Korea will find their revenue has increased
    d. Korean companies that sell their products in the United States will find that their revenue has decreased

11. A foreign exchange forward contract _____.
    a. is a standardized contract that is inflexible
    b. occurs when a company swaps its translation exposure for transaction exposure
    c. is a contractual agreement between two parties to exchange a specified amount of currencies on a future date
    d. states the date on which a trade will take place, but the price for the trade will be determined at the time the trade occurs

12. Which of the following is a measure of interest rate risk?
    a. LIBOR
    b. Duration
    c. Translation exposure

**d.** Contract inflexibility

**13.** A swap occurs when _____.
**a.** a company exchanges obligations with another company to make specified payment streams
**b.** a company purchases commodities from a company in another country, exposing it to both commodity and currency risk
**c.** a company chooses a local supplier over an international supplier to avoid currency exposure
**d.** a company chooses a foreign supplier so that its commodity risk will be offset by its currency risk

## Review Questions

1. What is the difference between someone using a derivative security to hedge risk and someone using a derivative security to speculate?
2. Explain how vertical integration may be used as a method of hedging against commodity price risk.
3. What is the difference between a forward contract and a futures contract?
4. You are considering purchasing a call option to purchase Mexican pesos in three months with a strike price of MXN 20/USD. The premium for this call option is MXN 2. Show the payoff you will receive at various prices in a diagram.
5. You are considering writing a call option to purchase Mexican pesos in three months with a strike price of MXN 20/USD. The premium for this call option is MXN 2. Show the payoff you will receive at various prices in a diagram.
6. Why are options considered to be a "zero-sum game"?

## Problems

1. The Olive Orchard is a US retail outlet for high-quality olive oils. One of the major suppliers of olive oil for the company is a farm in Greece. The Olive Orchard must pay the Greek farm 5.00 euros per liter of olive oil it purchases. The Olive Orchard would like to purchase 7,000 liters of the Greek farm's olive oil next year. Currently, it costs 0.900 euros to purchase 1 US dollar. If the exchange rate remains constant, how much will it cost the Olive Orchard (in US dollars) to purchase the 7,000 liters? If the exchange rate changes so that it costs 0.8599 euros to purchase 1 US dollar, how much will it cost to purchase the 7,000 liters of olive oil?
2. International Automobile Parts (IAP) holds a call option to purchase US dollars. The strike price on the call option is JPY 115/USD. IAP paid JPY 10 for the option. The spot price is JPY 120/USD, and the option expires today. Should IAP exercise the option? What is IAP's payoff?
3. Global Producers (GP) holds a put option to sell US dollars. The strike price on the put option is JPY 114/USD. GP paid JPY 10 for the option. The spot price is JPY 120/USD, and the option expires today. Should GP exercise the option? What is GP's payoff?

## Video Activity

### Hedging at Southwest Airlines

Access multimedia content (http://openstax.org/books/principles-finance/pages/20-video-activity)
Jet fuel costs represent a major expense for airlines. Southwest Airlines has been known as the most aggressive airline when it comes to hedging the risk of jet fuel cost volatility. In this interview, the CEO of Southwest Airlines, Gary Kelly, discusses crude oil prices in the spring of 2012 and the impact on Southwest Airlines.

1. How volatile are oil prices, and how large of an impact does that volatility have on the cost structure of an

airline?

2. Gary Kelly states that he sees fuel prices as the largest single business risk Southwest Airlines faces and that hedging that risk has become more expensive. Why do you think it became more expensive for Southwest Airlines to hedge this risk in 2012?

## BMW in the United States

Access multimedia content (http://openstax.org/books/principles-finance/pages/20-video-activity)

While the name BMW may sound German, a significant amount of BMW's production occurs outside of Germany. Watch this video to learn about this international activity of BMW.

3. In the video, the potential car buyer is concerned about the impact of the value of the euro on the price of the BMW. Why, if he is paying for the car in US dollars, do you think that he is impacted by the currency exchange rate?
4. How do you think opening plants in the United States, and in other parts of the world, provides a currency hedge for BMW?

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