FUNDAMENTALS OF CORPORATE FINANCE

FOURTH EDITION

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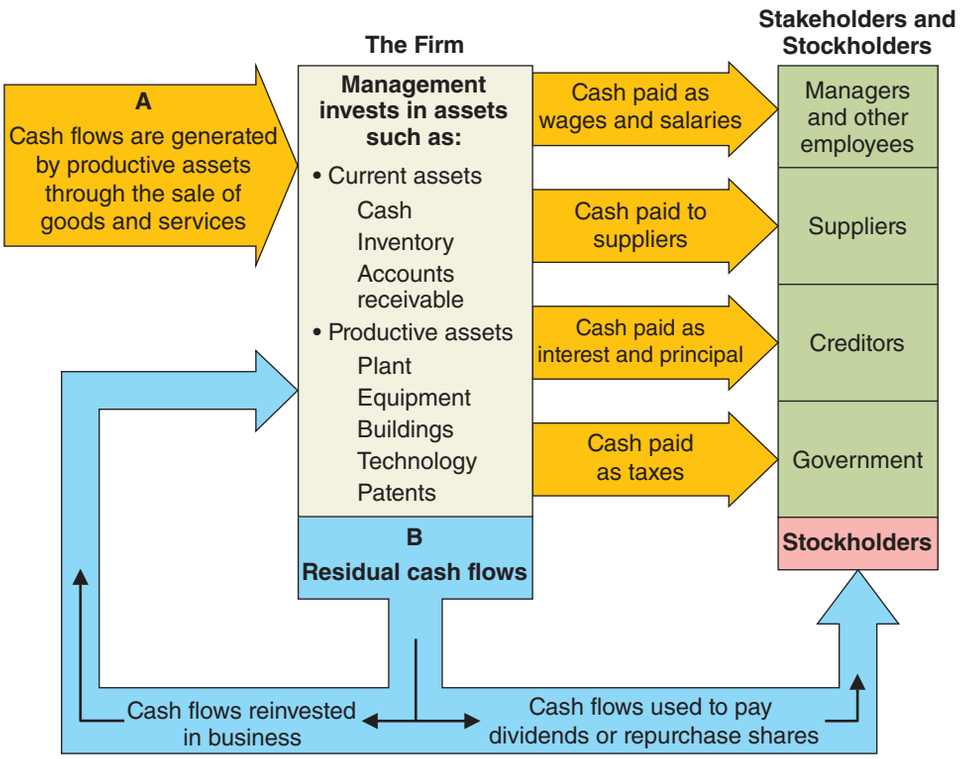


EXHIBIT 1.1 **Cash Flows Between the Firm and Its Stakeholders and Owners (Stockholders)**

A. Making business decisions is all about cash flows, because only cash can be used to pay bills and buy new assets. Cash initially flows into the firm as a result of the sale of goods or services. These cash inflows are used in a number of ways: to pay wages and salaries, to buy supplies, to repay creditors, and to pay taxes.

B. Any cash that is left over (residual cash flows) can be reinvested in the business or paid as dividends to stockholders.

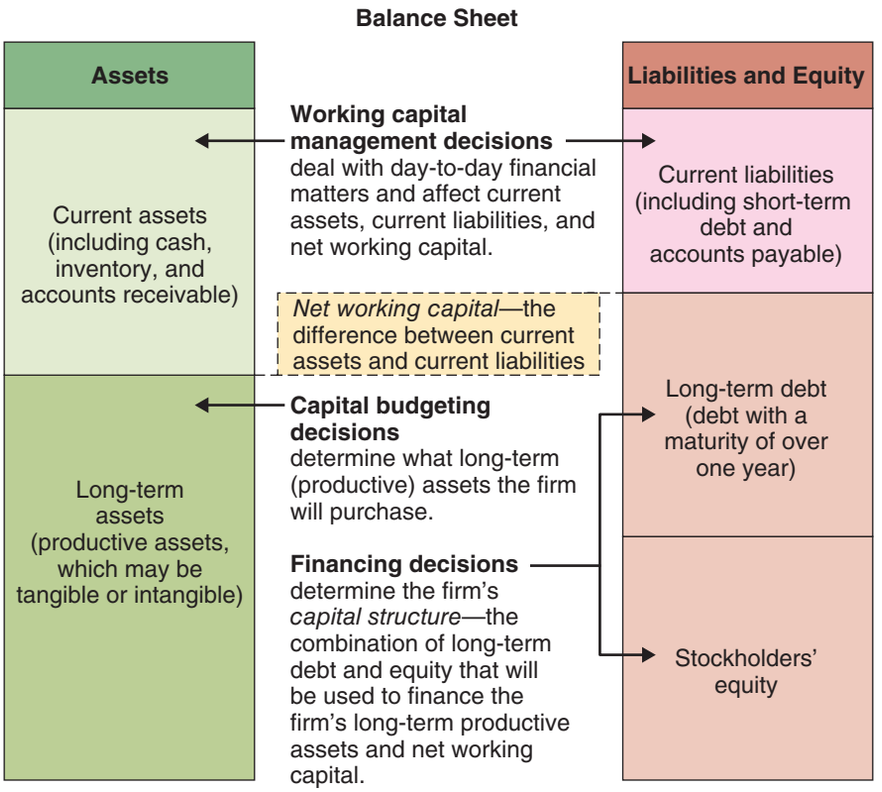


EXHIBIT 1.2 **How the Financial Manager's Decisions Affect the Balance Sheet**

Financial managers are concerned with three fundamental types of decisions: capital budgeting decisions, financing decisions, and working capital management decisions. Each type of decision has a direct and important effect on the firm's balance sheet and, ultimately, the success or failure of the firm.

EXHIBIT 1.3 **Characteristics of Different Forms of Business Organization**

Choosing the appropriate form of business organization is an important step in starting a business. This exhibit compares key characteristics of the most popular forms of business organization in the United States.

	Sole Proprietorship	Partnership		Corporation		Limited Liability Partnership (LLP) or Company (LLC)
		General	Limited	S-Corp.	C-Corp.	
Cost to establish	Inexpensive	More costly	More costly	More costly	More costly	More costly
Life of entity	Limited	Flexible	Flexible	Indefinite	Indefinite	Flexible
Control by founder over business decisions	Complete	Shared	Shared	Depends on ownership	Depends on ownership	Shared
Access to capital	Very limited	Limited	Less limited	Less limited	Excellent	Less limited
Cost to transfer ownership	High	High	High	High	Can be low	High
Separation of management and investment	No	No	Yes	Yes	Yes	Yes
Potential owner/ manager conflicts	No	No	Some	Potentially high	Potentially high	Some
Ability to provide incentives to attract and retain high-quality employees	Limited	Good	Good	Good	Good	Good
Liability of owners	Unlimited	Unlimited	Unlimited for general partner	Limited	Limited	Limited
Tax treatment of income	Flow-through	Flow-through	Flow-through	Flow-through	Double tax	As elected
Tax deductibility of owner benefits	Limited	Limited	Limited	Limited	Less limited	Limited

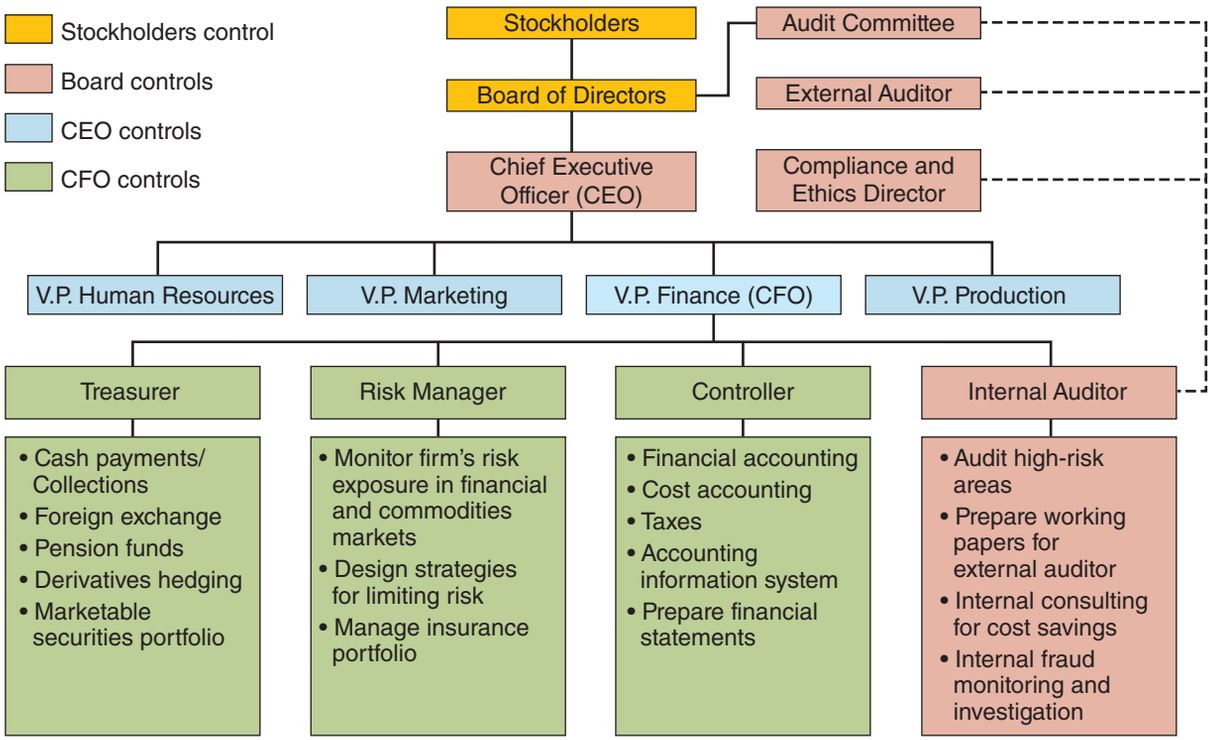


EXHIBIT 1.4 **Simplified Corporate Organization Chart**

The firm's top finance and accounting executive is the CFO, who reports directly to the CEO. Positions that report directly to the CFO include the treasurer, risk manager, and controller. The internal auditor reports both to the CFO and to the audit committee of the board of directors. The external auditor and the compliance and ethics director also are ultimately responsible to the audit committee.

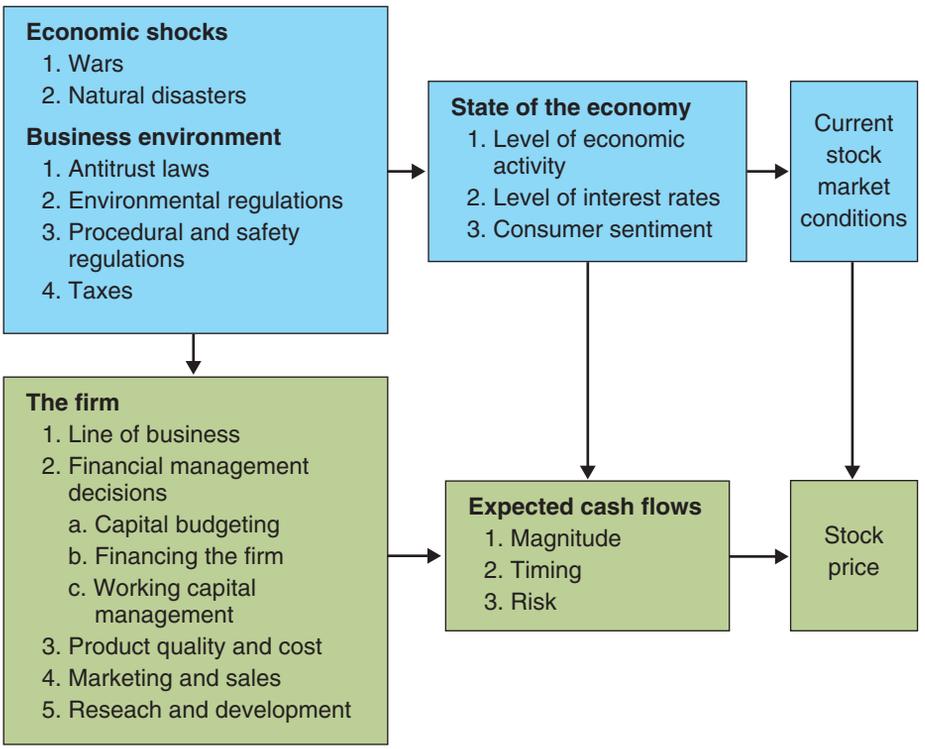


EXHIBIT 1.5 **Major Factors Affecting Stock Prices**

The firm's stock price is affected by a number of factors, and management can control only some of them. Managers exercise little control over external conditions (blue boxes), such as the state of the general economy, although they can closely observe these conditions and make appropriate changes in strategy. Also managers make many other decisions that directly affect the firm's expected cash flows (green boxes)—and hence the price of the firm's stock.

EXHIBIT 1.6 Corporate Governance Regulations Designed to Reduce Agency Costs

These are regulatory requirements that are designed to reduce agency costs. The most important requirements resulted from the Sarbanes-Oxley Act, passed by Congress in 2002. The act was aimed at reducing agency costs, promoting ethical conduct, and improving the integrity of accounting reporting systems.

Board of Directors

- Board has a fiduciary responsibility to represent the best interest of the firm's owners.
- Majority of the board must be outside independent directors.
- Firm is required to have a code of ethics, which has to be approved by the board.
- Firm must establish an ethics program that has a complaint hotline and a whistleblower protection provision that is approved by the board.
- Separation of chairperson and CEO positions is recommended.
- Board members can be fined or receive jail sentences if they fail to fulfill their fiduciary responsibilities.

Audit Committee

- External auditor, internal auditor, and compliance and ethics director's fiduciary (legal) responsibilities are to the audit committee.
- Audit committee approves the hiring, firing, and fees paid to external auditors.
- CEO and CFO must certify financial statements.
- All audit committee members must be outside independent directors.
- One member must be a financial expert.

External Auditor

- Lead partner must change every five years.
- There are limits on consulting (nonaudit) services that external auditors can provide.

Sources: Sarbanes-Oxley Act, Public Accounting Reform and Investor Protection Act, and NYSE and NASDAQ new listing requirements.

EXHIBIT 1.7 A Framework for the Analysis of Ethical Conflicts

Dealing with ethical conflicts is an inescapable part of professional life for most people. An analytical framework can be helpful in understanding and resolving such conflicts.

The first step toward ethical behavior is to recognize that you face a moral issue. In general, if your actions or decisions will cause harm to others, you are facing a moral issue. When you find yourself in this position, you might ask yourself the following questions:

1. What does the law require? When in doubt, consult the legal department.
2. What do your role-related obligations require? What is your station, and what are its duties? If you are a member of a profession, what does the code of conduct of your profession say you should do in these circumstances?
3. Are you an agent employed on behalf of another in these circumstances? If so, what are the interests and desires of the employing party?
4. Are the interests of the stockholders materially affected? Your obligation is to represent the best interests of the firm's owners.
5. Do you have a conflict of interest? Will full diclosure of the conflict be sufficient? If not, you must determine what interest has priority.
6. Are you abusing an information asymmetry? Is your use of the information asymmetry fair? It probably is fair if you would make the same decision if the roles of the parties were reversed or if you would publicly advocate the principle behind your decision.
7. Would you be willing to have your action and all the reasons that motivated it reported in the *Wall Street Journal*?

Self-Study Problems

1.1 Give an example of a capital budgeting decision and a financing decision.

1.2 What is the appropriate decision criterion for financial managers to use when selecting a capital project?

1.3 What are some of the things that managers do to manage a firm's working capital?

1.4 Which one of the following characteristics does not pertain to corporations?

a. Can enter into contracts.

b. Can borrow money.

c. Are the easiest type of business to form.

d. Can be sued.

e. Can own stock in other companies.

1.5 What are typically the main components of an executive compensation package?

Solutions to Self-Study Problems

1.1 Capital budgeting involves deciding which productive assets the firm invests in, such as buying a new plant or investing in the renovation of an existing facility. Financing decisions determine how a firm will raise capital. Examples of financing decisions include the decision to borrow from a bank or issue debt in the public capital markets.

1.2 Financial managers should select a capital project only if the value of the project's expected future cash flows exceeds the cost of the project. In other words, managers should only make investments that will increase firm value and thus increase the stockholders' wealth.

1.3 Working capital management is the day-to-day management of a firm's short-term assets and liabilities. Working capital can be managed by maintaining the optimal level of inventory, managing receivables and payables, deciding to whom the firm should extend credit, and making appropriate investments with excess cash.

1.4 The answer that does *not* pertain to corporations is: **c.** Are the easiest type of business to form.

1.5 The three main components of a typical executive compensation package are base salary, bonus based on accounting performance, and compensation tied to the firm's stock price.

Discussion Questions

1.1 Describe the cash flows between a firm and its stakeholders.

1.2 What are the three fundamental decisions the financial manager is concerned with, and how do they affect the firm's balance sheet?

1.3 What is the difference between stockholders and stakeholders?

1.4 Suppose that a group of accountants wants to start an accounting business. What organizational form would they most likely choose, and why?

1.5 Why would the owners of a business choose to form a corporation even though they will face double taxation?

1.6 Explain why profit maximization is not the best goal for a company. What is a better goal?

1.7 What are some of the major external and internal factors that affect a firm's stock price? What is the difference between the two general types of factors?

1.8 Identify the sources of agency costs. What are some ways these costs can be controlled in a company?

1.9 What is the Sarbanes-Oxley Act, and what is its focus? Why does it focus in these areas?

1.10 Give an example of a conflict of interest in a business setting, other than the one involving the real estate agent discussed in the chapter text.

Questions and Problems

Basic

1.1 Capital: What are the two basic sources of funds for all businesses?

1.2 Management role: What is net working capital?

1.3 Cash flows: Explain the difference between profitable and unprofitable firms.

1.4 Management role: What three major decisions are of most concern to financial managers?

1.5 Cash flows: What is the appropriate decision rule for a firm considering undertaking a capital project? Give a real-life example.

1.6 Management role: What is a firm's capital structure, and why is it important?

1.7 Management role: What are some of the working capital decisions that a financial manager faces?

1.8 Organizational form: What are the common forms of business organization discussed in this chapter?

1.9 Organizational form: What are the advantages and disadvantages of a sole proprietorship?

1.10 Organizational form: What is a partnership, and what is the biggest disadvantage of this form of business organization? How can this disadvantage be avoided?

1.11 Organizational form: Who are the owners of a corporation, and how is their ownership represented?

1.12 Organizational form: Explain what is meant by stockholders' limited liability.

1.13 Organizational form: What is double taxation?

1.14 Organizational form: What is the form of business organization taken by most large companies and why?

1.15 Finance function: What is the primary responsibility of the board of directors in a corporation?

1.16 Finance function: All public companies must hire a certified public accounting firm to perform an independent audit of their financial statements. What exactly does the term *audit* mean?

1.17 Firm's goal: What are some of the drawbacks to setting profit maximization as the main goal of a company?

1.18 Firm's goal: What is the appropriate goal of financial managers? How do managers' decisions affect how successful the firm is in achieving this goal?

1.19 Firm's goal: What are the major factors that affect a firm's stock price?

1.20 Agency conflicts: What is an agency relationship, and what is an agency conflict? How can agency conflicts be reduced in a corporation?

1.21 Firm's goal: What can happen if a firm is poorly managed and its stock price falls substantially below its maximum potential price?

1.22 Agency conflicts: What are some of the regulations that pertain to boards of directors that were put in place to reduce agency conflicts?

1.23 Business ethics: How can a lack of business ethics negatively affect the performance of an economy? Give an example.

1.24 Agency conflicts: What are some ways to resolve a conflict of interest?

1.25 Information asymmetry: Describe what an information asymmetry is in a business transaction. Explain how the inequity associated with an information asymmetry might be, at least partially, solved through the market for goods or services.

1.26 Business ethics: What ethical conflict does insider trading present?

Sample Test Problems

1.1 Identify three fundamental types of decisions that financial managers make and identify which part of the balance sheet each of these decisions affects.

1.2 Which of the following is/are advantages of the corporate form of organization?

- **a.** Reduced start-up costs.
- **b.** Greater access to capital markets.
- **c.** Unlimited liability.
- **d.** Single taxation.

1.3 Why is stock value maximization superior to profit maximization as a goal for management?

1.4 What are agency costs? Explain.

1.5 Identify seven mechanisms that can help better align the goals of managers with those of stockholders.

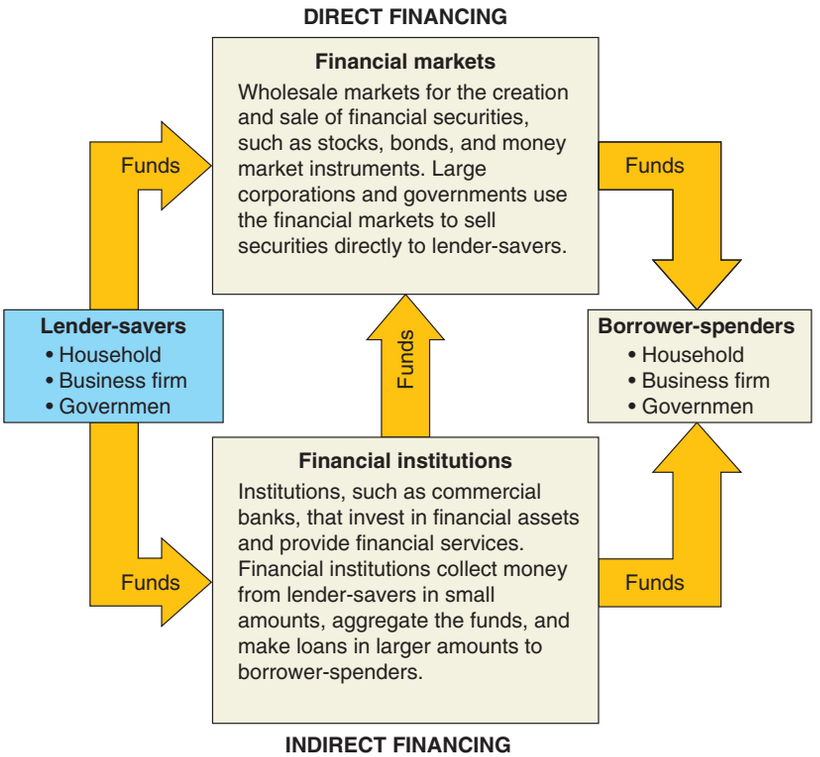
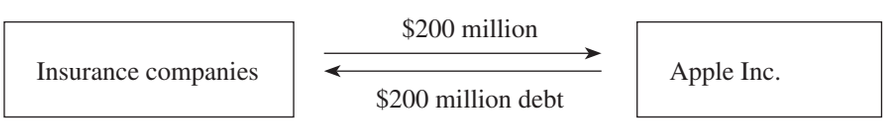


EXHIBIT 2.1 **The Flow of Funds through the Financial System**

The role of the financial system is to gather money from households, businesses, or governments with surplus funds and channel it to those who need it. Money flows through the financial system in two basic ways: *directly,* through wholesale financial markets, as shown in the top route of the diagram, and *indirectly,* through financial institutions, as shown in the bottom route.

Figure 2.1



LEARNING BY DOING

APPLICATION 2.1 | Underwriter's Compensation

Problem Dairy Queen needs to raise $5 million to build three new restaurants and its financial manager decides to issue long-term bonds. The financial manager hires an investment banking firm to help design the bond issue and underwrite it. The issue consists of 5,000 bonds, and the investment banker agrees to purchase the entire issue for $4.8 million. The investment banker then resells the bonds to investors at the offering price. The sale totals $5.0 million. What is the underwriter's compensation?

Approach The underwriter's compensation is the underwriting spread, which is the difference between the price at which the bonds were resold to investors and the price the underwriter paid for the issue. The underwriting spread per bond is then calculated by dividing the total spread by the number of bonds that are issued.

Solution

Underwriting spread: $5,000,000 − $4,800,000 = $200,000

Underwriting spread per bond: $200,000/5,000 bonds = $40

Since the bonds are sold for $1,000 each ($5,000,000/5,000 bonds = $1,000 per bond), the underwriting spread is 4 percent of the bond price. Notice that because of the guarantee Dairy Queen gets a check from the underwriter for $4.8 million regardless of the price at which the bonds are resold.

EXHIBIT 2.2 **Selected Money Market and Capital Market Instruments, December 2016 ($ billions)**

The exhibit shows the size of the U.S. market for each of the most important money market and capital market instruments. Notice that the largest security market is the market for corporate stock, followed by those for mortgage debt, corporate bonds, and Treasury notes. Compared with money market instruments, capital market instruments are less marketable, have higher default risk, and have longer maturities.

Money Market Instruments		
Treasury bills		$ 1,818
Commercial paper		911
	Total	$ 2,729
Capital Market Instruments		
Treasury notes		$ 8,659
Treasury bonds*		3,444
State and local government bonds		3,051
Corporate bonds		9,741
Corporate stock (at market value)		30,077
Mortgage debt		14,188
	Total	$69,160

*Includes Treasury inflation-protected securities, floating rate notes, and Federal Financing Bank securities.

Sources: Board of Governors, Federal Reserve System, Flow of Funds, Balance Sheets, and Integrated Macroeconomic Accounts (December 8, 2016) and Bureau of Public Debt, Monthly Statement of the Public Debt of the United States (December 31, 2016).

Figure 2.2

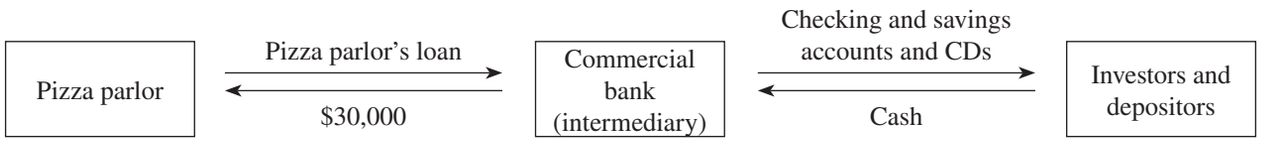
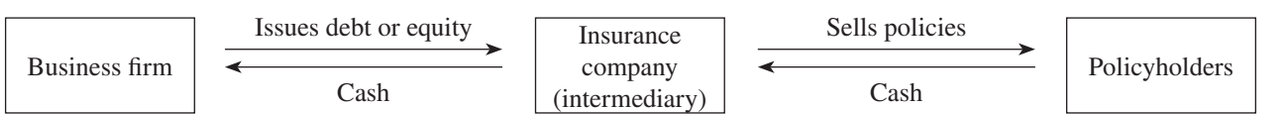


Figure 2.3



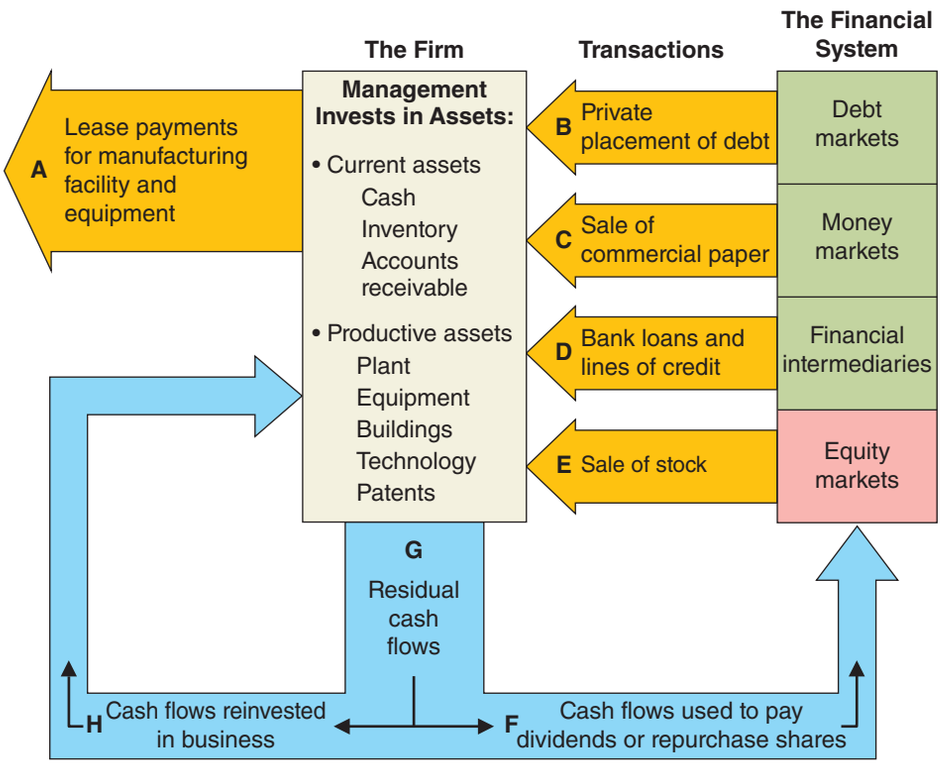


EXHIBIT 2.3 **Cash Flows between the Firm and the Financial System**

This exhibit shows how the financial system helps businesses finance their activities. The arrows in the exhibit indicate the major cash flows into and out of a firm over a typical operating cycle. Money obtained from the financial system, combined with reinvested cash flows from operations, enables a firm to make necessary investments and fund any other requirements.

EXAMPLE 2.1 | Capital Budgeting Preview

DECISION MAKING

Situation Sonic Manufacturing Company's capital budget includes six projects that management has identified as having merit. The CFO's staff computed the return on investment for each project. The average cost of funding each project is 10 percent. The projects are as follows:

Project	Return on Investment
A	13.0%
B	12.0
C	10.9
D	10.5
E	9.8
F	8.9

Which capital projects should the firm undertake?

Decision The firm should accept all projects with a return on investment greater than the average cost of funding, which is 10 percent in all cases. These projects are A, B, C, and D. As noted in the text, this decision-making principle makes intuitive sense because all projects with a return on investment greater than the cost of funds will increase the value of the firm. In Chapters 10 through 13, we will delve much more deeply into capital budgeting, and you will find out a great deal more about how these decisions are made.

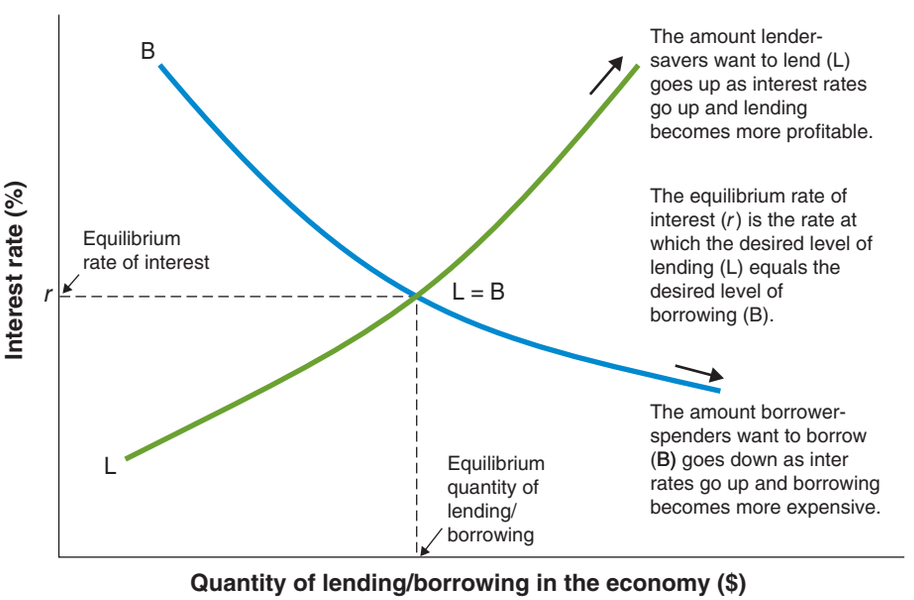


EXHIBIT 2.4 **The Determinants of the Equilibrium Rate of Interest**

The equilibrium rate of interest is a function of supply and demand. Lender-savers are willing to supply more funds as interest rates go up, but borrower-spenders demand fewer funds at higher interest rates. The interest rate at which the supply of funds equals the demand for those funds is the equilibrium rate.

$$1 + i = (1 + r) \times (1 + \Delta P_e) \tag{2.1}$$
$$1 + i = 1 + r + \Delta P_e + r\,\Delta P_e$$
$$i = r + \Delta P_e + r\,\Delta P_e$$

$$i = r + \Delta P_e \tag{2.2}$$

LEARNING BY DOING

APPLICATION 2.2 | Calculating a New Inflation Premium

Problem The current one-year Treasury bill rate is 2.0 percent. On the evening news, several economists at leading investment and commercial banks predict that the annual inflation rate is going to be 0.25 percent higher than originally expected. The higher inflation forecasts reflect unexpectedly strong employment figures released by the government that afternoon. What is the current inflation premium if the real rate of interest is 0.5 percent? When the market opens tomorrow, what should happen to the one-year Treasury bill rate?

Approach You must first estimate the current inflation premium using Equation 2.2. You should then adjust this premium to reflect the economists' revised beliefs. Finally, this revised inflation premium can be used in the simplified Fisher equation to estimate what the Treasury rate will be tomorrow morning.

Solution Current inflation premium:

$$\begin{aligned} i &= r + \Delta P_e \\ \Delta P_e &= i - r \\ &= 2.0\% - 0.5\% \\ &= 1.5\% \end{aligned}$$

New inflation premium:

$$\Delta P_e = 1.5\% + 0.25\% = 1.75\%$$

The opening Treasury rate in the morning:

$$i = r + \Delta P_e = 0.5\% + 1.75\% = 2.25\%$$

LEARNING BY DOING

APPLICATION 2.3 | International Loan Rate

Problem You are a financial manager at a manufacturing company that is going to make a one-year loan to a key supplier in another country. The loan will be made in the supplier's local currency. The supplier's government controls the banking system, and there are no reliable market data available. For this reason, you have spoken with five economists who have some knowledge about the economy. Their predictions for inflation next year are 30, 40, 45, 50, and 60 percent.

What rate should your firm charge for the one-year business loan if you are not concerned about the possibility that your supplier will default? You recall from your corporate finance course that the real rate of interest is, on average, 3 percent over the long run.

Approach Although the sample of economists is small, an average of the economists' estimates should provide a reasonable estimate of the expected rate of inflation (ΔP_e). This value can be used in Equation 2.2 to calculate the nominal rate of interest.

Solution

$$\begin{aligned}\Delta P_e &= (30\% + 40\% + 45\% + 50\% + 60\%)/5\\ &= 225\%/5\\ &= 45\%\end{aligned}$$

Nominal rate of interest:

$$\begin{aligned}i &= r + \Delta P_e\\ &= 3\% + 45\%\\ &= 48\%\end{aligned}$$

This number is a reasonable estimate, given that you have no market data.

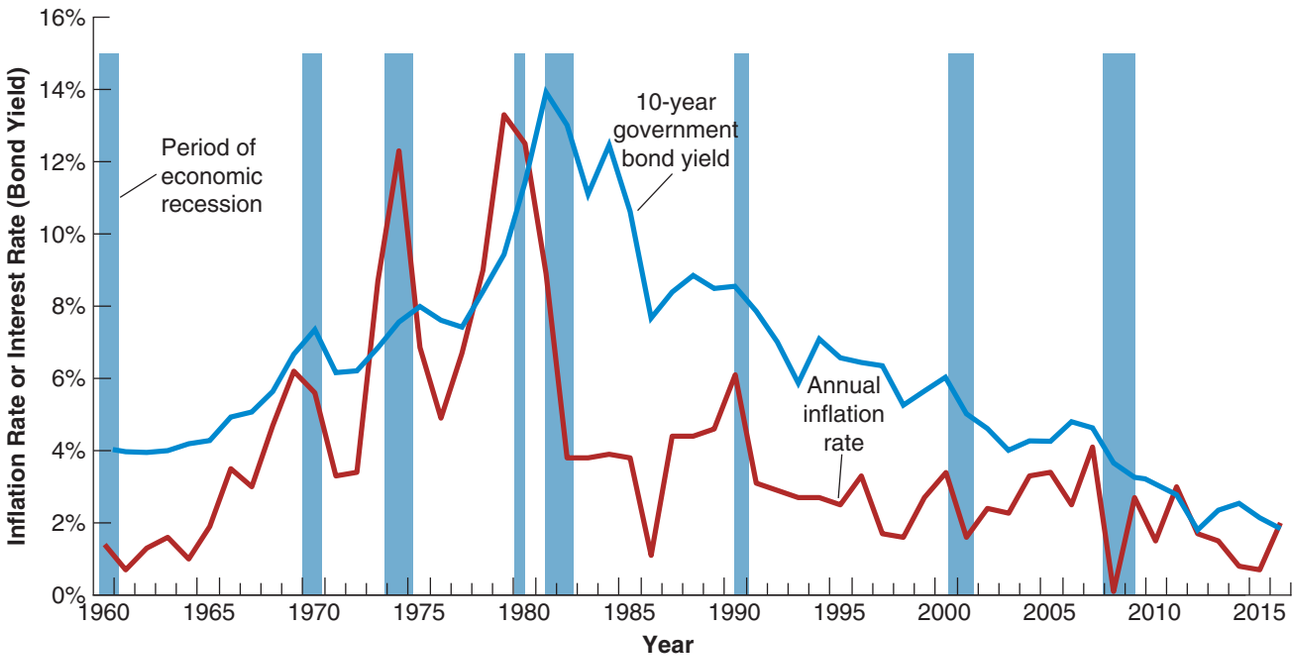


EXHIBIT 2.5 **Relation between Annual Inflation Rate and Long-Term Interest Rate (1960–2016)**

Based on the graph shown in the exhibit, we can draw two important conclusions about interest rate movements. First, the level of interest rates tends to rise and fall with the actual rate of inflation—a conclusion also supported by the Fisher equation, which suggests that interest rates rise and fall with the *expected* rate of inflation. Second, the level of interest rates tends to rise during periods of economic expansion and decline during periods of economic contraction.

Sources: Bureau of Labor Statistics, U.S. Department of Labor (http://www.bls.gov/cpi), U.S. Department of the Treasury (http://www.treasury.gov), and Wikipedia (http://en.wikipedia.org).

Summary of Key Equations

Equation	Description	Formula
2.1	Fisher equation	$1 + i = (1 + r) \times (1 + \Delta P_e)$ $i = r + \Delta P_e + r\Delta P_e$
2.2	Simplified or approximate Fisher equation	$i = r + \Delta P_e$

Self-Study Problems

2.1 Economic units that need to borrow money are said to be:

a. Lender-savers.

b. Borrower-spenders.

c. Balanced budget keepers.

d. None of the above.

2.2 Explain what the marketability of a security is and how it is determined.

2.3 What are over-the-counter markets (OTCs), and how do they differ from organized exchanges?

2.4 What effect does an increase in demand for business goods and services have on the real interest rate? What other factors can affect the real interest rate?

2.5 How does the business cycle affect the nominal interest rate and inflation rate?

2.6 You lent $100 to a friend for one year at a nominal rate of interest of 3 percent. Inflation during that year was 2 percent. Did you experience an increase or decrease in the purchasing power of your money? How much did it increase or decrease?

Solutions to Self-Study Problems

2.1 Such units are said to be: b. Borrower-spenders.

2.2 Marketability refers to the ease with which a security can be sold and converted into cash. The level of marketability depends on the cost of trading the security and the cost of searching for information. The lower these costs are, the greater the security's marketability.

2.3 Securities that are not listed on an organized exchange are sold OTC. An OTC market differs from an organized exchange in that there is no central trading location. OTC security transactions are made via phone or computer as opposed to on the floor of an exchange.

2.4 An increase in the demand for business goods and services will cause the borrowing schedule in Exhibit 2.4 to shift to the right, thus increasing the real rate of interest. Other factors that can affect the real interest rate include increases in productivity, changes in technology, or changes in the corporate tax rate. Demographic factors, such as growth or age of the population, and cultural differences can also affect the real rate of interest.

2.5 Both the nominal interest and inflation rates tend to follow the business cycle; that is, they rise with economic expansion and fall during a recession.

2.6 Since the interest rate that you received (3 percent) exceeded the rate of infl ation, the amount that you received from your friend when the loan was repaid had greater purchasing power than $100. The amount by which the purchasing power increased can be calculated using Equation 2.1:

$1 + i = (1 + r) \times (1 + \Delta P_e)$

Solving for r yields:

$r = (1 + i)/(1 + \Delta P_e) - 1$

$r = (1 + 0.03)/(1 + 0.02) - 1$

$r = 0.0098$, or 0.98%

Therefore, the purchasing power increased by slightly less than 1 percent.

Discussion Questions

2.1 Explain why total financial assets in the economy must equal total financial liabilities.

2.2 Why don't small businesses make greater use of the direct credit markets since these markets enable firms to finance their activities at a very low cost?

2.3 Explain the economic role of brokers and dealers. How does each make a profit?

2.4 Why were commercial banks prohibited from engaging in invest-ment banking activities until 1999?

2.5 What are two basic services that investment banks provide in the economy?

2.6 How do large corporations adjust their liquidity in the money markets?

2.7 The CFO of a certain company always wears his green suit on a day that the firm is about to release positive information about his company. You believe that you can profit from this information by buying the fi rm's shares at the beginning of every day that the CFO shows up wearing this green suit. Describe which form of market efficiency is consistent with your belief.

2.8 Shouldn't the nominal rate of interest (Equation 2.1) be determ-ined by the actual rate of inflation (ΔP_a), which can be easily meas-ured, rather than by the expected rate of inflation (ΔP_e)?

2.9 How does Exhibit 2.5 help explain why interest rates were so high during the early 1980s as compared to the relatively low interest rates in the early 1960s?

2.10 When determining the real interest rate, what happens to busi-nesses that find themselves with unfunded capital projects whose rate o f return exceeds the cost of capital?

Questions and Problems

Basic

2.1 Financial system: What is the role of the financial system, and what are the two major components of the financial system?

2.2 Financial system: What does a competitive financial system imply about interest rates?

2.3 Financial system: What is the difference between saver-lenders and borrower-spenders, and who are the major representatives of each group?

2.4 Financial markets: List the two ways in which a transfer of funds takes place in an economy. What is the main difference between these two?

2.5 Financial markets: Suppose you own a security that you know can be easily sold in the secondary market, but the security will sell at a lower price than you paid for it. What does this imply for the security's marketability and liquidity?

2.6 Financial markets: Why are direct financial markets also called wholesale markets?

2.7 Financial markets: Trader Inc. is a $300 million company, as measured by asset value, and Horst Corp. is a $35 million company. Both are privately held corporations. Explain which fi rm is more likely to go public and register with the SEC, and why.

2.8 Primary markets: What is a primary market? What does IPO stand for?

2.9 Primary market: Identify whether the following transactions are primary market or secondary market transactions.

- **a.** Jim Hendry bought 300 shares of IBM through his brokerage account.
- **b.** Peggy Jones bought $5,000 of General Motors bonds from another investor.
- **c.** Hathaway Insurance Company bought 500,000 shares of Trigen Corp. when the company issued stock.

2.10 Investment banking: What does it mean to "underwrite" a new security issue? What compensation does an investment banker get from underwriting a security issue?

2.11 Investment banking: Cranjet Inc. is issuing 10,000 bonds, and its investment banker has guaranteed a price of $985 per bond. If the investment banker sells the entire issue to investors for $10,150,000:

- **a.** What is the underwriting spread for this issue?
- **b.** What is the percentage underwriting cost?
- **c.** How much will Cranjet raise?

2.12 Financial institutions: What are some of the ways in which a financial institution or intermediary can raise money?

2.13 Financial institutions: How do financial institutions act as intermediaries to provide services to small businesses?

2.14 Financial institutions: Which financial institution is usually the most important to businesses?

2.15 Financial markets: What is the main difference between money markets and capital markets?

2.16 Money markets: What is the primary role of money markets? Explain how the money markets work.

2.17 Money markets: What are the main types of securities in the money markets?

2.18 Capital markets: How do capital market instruments differ from money market instruments?

2.19 Market efficiency: Describe the informational differences that distinguish the three forms of market efficiency.

2.20 Market efficiency: Zippy Computers announced strong fourth quarter results. Sales and earnings were both above analysts' expectations. You notice in the newspaper that Zippy's stock price went up sharply on the day of the announcement. If no other information about Zippy became public on the day of the announcement and the overall market was down, is this evidence of market efficiency?

2.21 Market efficiency: In Problem 2.20, if the market is efficient, would it have been possible for Zippy's stock price to go down in the day that the fi rm announced the strong fourth quarter results?

2.22 Market efficiency: If the market is strong-form efficient, then trading on tips you hear from Jim Cramer (the host of *Mad Money* on CNBC) will generate no excess returns (i.e., returns in excess of fair compensation for the risk you are bearing). True or false?

2.23 Financial markets: What are the major differences between public and private markets?

2.24 Financial instruments: What are the two risk-hedging instruments discussed in this chapter?

2.25 Interest rates: What is the real rate of interest, and how is it determined?

2.26 Interest rates: How does the nominal rate of interest vary over time?

2.27 Interest rates: What is the Fisher equation, and how is it used?

2.28 Interest rates: Imagine you borrow $500 from your roommate, agreeing to pay her back $500 plus 7 percent nominal interest in one year. Assume inflation over the life of the contract is expected to be 4.25 percent. What is the total dollar amount you will have to pay her back in a year? What percentage of the interest payment is the result of the real rate of interest?

2.29 Interest rates: Your parents gave you $1,000 a year before your graduation date so that you can take a trip when you graduate. You wisely decide to invest the money in a bank CD that pays 6.75 percent interest. You know that the trip costs $1,025 right now and that inflation for the year is predicted to be 4 percent. Will you have enough money in a year to purchase the trip?

2.30 Interest rates: When are the nominal and real interest rates equal?

Sample Test Problems

2.1 What are the two basic mechanisms through which funds flow through the financial system, and how do they differ?

2.2 You just purchased a share of IBM stock on the New York Stock Exchange. What kind of transaction was this?

a. Primary market transaction.

b. Secondary market transaction.

c. Futures market transaction.

d. Private placement.

2.3 How are brokers different from dealers?

2.4 List the three forms of the efficient market hypothesis, and describe what information is assumed to be reflected in security prices under each of these hypotheses.

2.5 If the nominal rate of interest is 4.25 percent and the expected rate of inflation is 1.75 percent, what is the real rate of interest?

2.6 What is the relation between business cycles and the general level of interest rates?

EXHIBIT 3.1 **Diaz Manufacturing Balance Sheets as of December 31 ($ millions)**

The left-hand side of the balance sheet lists the assets that the firm has at a particular point in time, while the right-hand side shows how the firm has financed those assets.

Assets	2017	2016	Liabilities and Stockholders' Equity	2017	2016
Cash[a]	$ 288.5	$ 16.6	Accounts payable and accruals	$ 349.3	$ 325.0
Accounts receivable	306.2	268.8	Notes payable	10.5	4.2
Inventories	423.8	372.7	Accured taxes	18.0	16.8
Other current assets	21.3	29.9	Total current liabilities	$ 377.8	$ 346.0
Total current assets	$1,039.8	$ 688.0	Long-term debt	574.0	305.6
			Total liabilities	$ 951.8	$ 651.6
Plant and equipment	911.6	823.3	Preferred stock[b]	—	—
Less: Accumulated depreciation	512.2	429.1	Common stock (54,566,054 shares)[c]	50.0	50.0
Net plant and equipment	$ 399.4	$ 394.2	Additional paid-in capital	842.9	842.9
			Retained earning	67.8	(50.7)
Goodwill and other assets	450.0	411.6	Treasury stock (571,320 shares)	(23.3)	—
			Total stockholders equity	$ 937.4	$ 842.2
Total assets	$1,889.2	$1,493.8	Total liabilities and equity	$1,889.2	$1,493.8

[a]Cash includes investments in marketable securities.
[b]10,000,000 preferred stock shares authorized.
[c]150,000,000 common stock shares authorized.

$$\text{Total assets} = \text{Total liabilities} + \text{Total stockholders' equity} \quad (3.1)$$

$$\text{Net working capital} = \text{Total current assets} - \text{Total current liabilities} \quad (3.2)$$

Figure 3.1

Marvel Airlines
Book-Value versus Market-Value Balance Sheets ($ millions)

Assets			Liabilities and Stockholders' Equity		
	Book	**Market**		**Book**	**Market**
Aircraft	$600	$400	Long-term debt	$300	$300
			Stockholders' equity	300	100
Total	$600	$400		$600	$400

LEARNING BY DOING

APPLICATION 3.1 | The Market-Value Balance Sheet

Problem Grady Means and his four partners in Menlo Park Consulting (MPC) have developed a revolutionary new continuous audit program that can monitor high-risk areas within a firm and identify abnormalities so that corrective actions can be taken. The partners have spent about $300,000 developing the program. The firm's bookkeeper records the audit program on the firm's balance sheet as an asset valued at cost, which is $300,000. To launch the product, the four partners recently invested an additional $1 million, and the money is currently in the firm's bank account. At a recent trade show, a number of accounting and financial consulting firms tried to buy the new continuous product—the highest offer being $15 million. Assuming these are MPC's only assets and liabilities, prepare the firm's book-value and market-value balance sheets and explain the difference between the two.

Approach The main differences between the two balance sheets will be the treatment of the $300,000 already spent to develop the program and the $15 million offer. The book-value balance sheet is a historical document, which means all assets are valued at what it cost to put them in service, while the market-value balance sheet reflects the value of the assets if they were sold under current market conditions. The differences between the two approaches can be considerable.

Solution The two balance sheets are as follows:

Menlo Park Consulting
Book-Value versus Market-Value Balance Sheets ($ thousands)

Assets			Liabilities and Stockholders' Equity		
	Book	Market		Book	Market
Cash in bank	$1,000	$ 1,000	Long-term debt	$ —	$ —
Intangible assets	300	15,000	Stockholders' equity	1,300	16,000
Total	$1,300	$16,000		$1,300	$16,000

The book-value balance sheet provides little useful information. The book value of the firm's total assets is $1.3 million, which consists of cash in the bank and the cost of developing the audit program. Since the firm has no debt, total assets must equal the book value of stockholders' equity. The market value tells a dramatically different story. The market value of the audit program is estimated to be $15.0 million; thus, the market value of stockholders' equity is $16.0 million and not $1.3 million as reported in the book-value balance sheet.

$$\text{Net income} = \text{Revenues} - \text{Expenses} \tag{3.3}$$

EXHIBIT 3.2 **Diaz Manufacturing Income Statements for the Fiscal Year Ending December 31 ($ millions)**

The income statement shows the sales, expenses, and profit earned by the firm over a specific period of time.

	2017	2016
Net sales[a]	$1,563.7	$1,386.7
Cost of goods sold	1,081.1	974.8
Selling and administrative expenses	231.1	197.4
Earnings before interest, taxes, depreciation, and amortization (EBITDA)	$ 251.5	$ 214.5
Depreciation and amortization	83.1	75.3
Earnings before interest and taxes (EBIT)	$ 168.4	$ 139.2
Interest expense	5.6	18.0
Earnings before taxes (EBT)	$ 162.8	$ 121.2
Taxes	44.3	16.1
Net income	$ 118.5	$ 105.1
Common stock dividend	—	—
Addition to retained earnings	$ 118.5	$ 105.1
Per-share data:		
Common stock price		
Earnings per share (EPS)	$ 2.17	$ 1.93
Dividends per share (DPS)	—	—
Book value per share (BVPS)	—	—
Cash flow per share (CFPS)	$ 3.69	$ 3.31

[a]Net sales is defined as total sales less all sales discounts and sales returns and allowances.

EXHIBIT 3.3 **Diaz Manufacturing Statement of Retained Earnings for the Fiscal Year Ending December 31, 2017 ($ millions)**

The statement of retained earnings accompanies the balance sheet and shows the beginning balance of retained earnings, the adjustments made to retained earnings during the year, and the ending balance.

Balance of retained earnings, December 31, 2016	$ (50.7)
Add: Net income, 2017	118.5
Less: Dividends to common stockholders, 2017	—
Balance of retained earnings, December 31, 2017	$ 67.8

EXHIBIT 3.4 **Diaz Manufacturing Statement of Cash Flows for the Fiscal Year Ending December 31, 2017 ($ millions)**

The statement of cash flows shows the sources of the cash that has come into the firm during a period of time and the ways in which this cash has been used.

Operating Activities	
Net income	$ 118.5
Additions (sources of cash)	
Depreciation and amortization	83.1
Increase in accounts payable	24.3
Decrease in other current assets	8.6
Increase in accrued income taxes	1.2
Subtractions (uses of cash)	
Increase in accounts receivable	(37.4)
Increase in inventories	(51.1)
Net cash provided by operating activities	$ 147.2
Long-Term Investing Activities	
Property, equipment, and other assets	$ (88.3)
Increase in goodwill and other assets	(38.4)
Net cash used in investing activities	$(126.7)
Financing Activities	
Increase in long-term debt	$ 268.4
Purchase of treasury stock	(23.3)
Increase in notes payable	6.3
Net cash provided by financing activities	$ 251.4
Cash Reconciliation[a]	
Net increase in cash and marketable securities	$ 271.9
Cash and securities at beginning of year	16.6
Cash and securities at end of year	$ 288.5

[a]Cash includes investments in marketable securities.

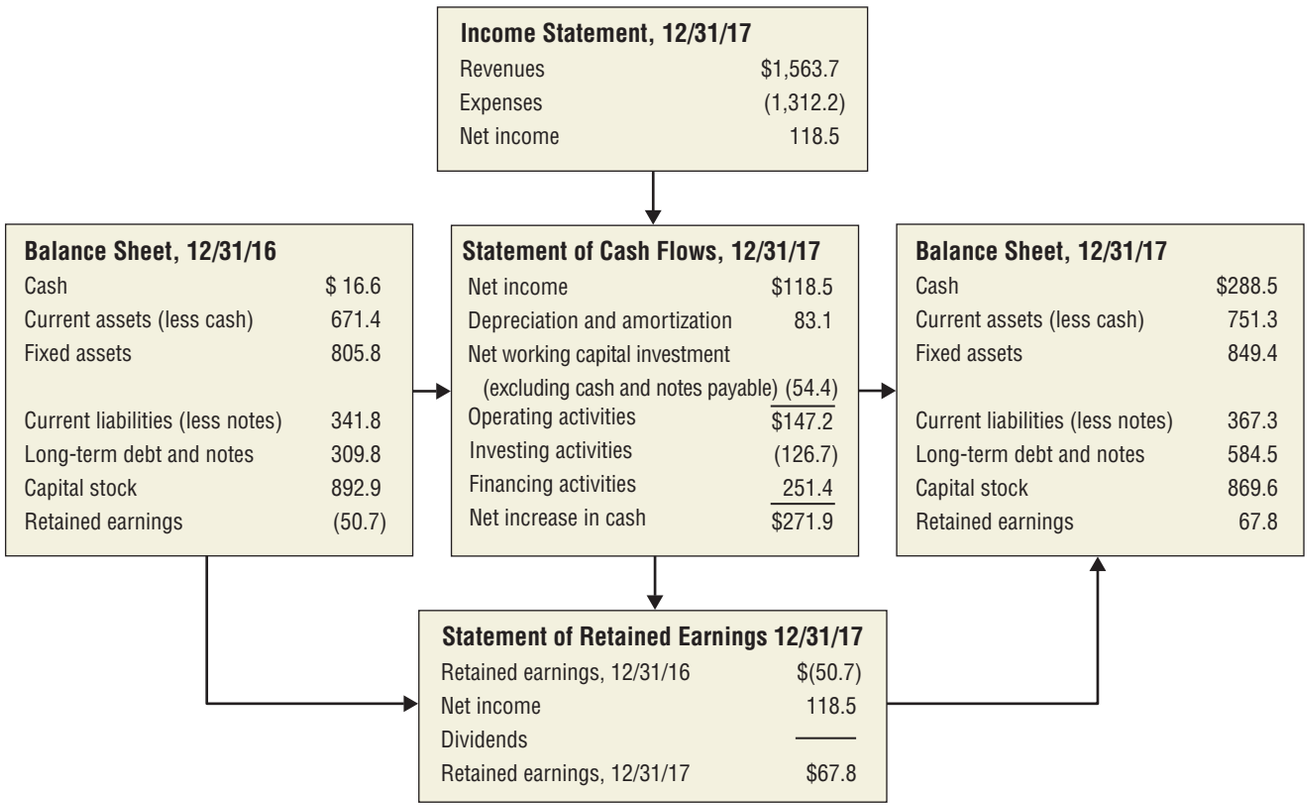


EXHIBIT 3.5 **The Interrelations among the Financial Statements: Illustrated Using Diaz Manufacturing Financial Results ($ millions)**

The statement of cash flows ties together the income statement with the balance sheets from the beginning and the end of the period. The statement of retained earnings shows how the retained earnings account has changed from the beginning to the end of the period.

$$\text{CFOA} = \text{EBIT} - \text{Current taxes} + \text{Noncash expenses} \tag{3.4}$$

EXAMPLE 3.1 | Cash Flow to Investors from Operating Activity

DECISION MAKING

Situation You are a financial manager at Bonivo Corporation and are preparing a report for senior management. You have asked two analysts who work for you to compute cash flow to investors from operating activity during the year that just ended. A short while later they come to your office and report that they cannot agree on how to do the calculation.

The first analyst thinks it should be computed as:

Net income
+ Depreciation and amortization
+ Increase in accounts payable
+ Increase in accrued income taxes
− Increase in accounts receivables
− Increase in inventories
− Increase in other current assets
= Cash flow to investors from operating activity

The second analyst proposes that the calculation is:

EBIT
− Current taxes
+ Depreciation and amortization
= Cash flow to investors from operating activity

Which calculation should you use for your report to senior management?

Decision You should use the calculation proposed by the second analyst. This is the correct calculation. The calculation proposed by the first analyst is incorrect. The first analyst has computed the net cash from operating activities as it is calculated in a statement of cash flows. This calculation does account for the firm's noncash depreciation and amortization expenses, but unlike the calculation of cash flow to investors from operating activity, it incorporates changes in the firm's working capital accounts other than cash and marketable securities. The first analyst also started from net income rather than EBIT. It is important to start from EBIT rather than net income when calculating cash flows for investors because the interest payments to debt holders are not deducted when EBIT is calculated.

$$\text{CFNWC} = \text{NWC}_{\text{current period}} - \text{NWC}_{\text{previous period}} \tag{3.5}$$

$$\text{CFLTA} = \text{Long-term assets}_{\text{current period}} - \text{Long-term assets}_{\text{previous period}} \tag{3.6}$$

APPLICATION 3.2

LEARNING BY DOING

Problem Alexi Ghosh and Paul Heaton are the founding partners of BitByte Inc., a leading developer of application delivery management software and solutions. Since opening for business in 2014, BitByte's revenue has nearly tripled. The partners would like to know more about how much cash flow the firm is investing in net working capital and long-term assets to facilitate this growth. While the firm has no inventory for software development, it has increasingly relied on accounts receivable as a term of sale. In addition, growth has required additional investment in long-term assets such as computing hardware, networking equipment, and facilities. Using the information in the following financial statements, calculate the cash flow invested in net working capital and the cash flow invested in long-term assets during fiscal year 2017 for BitByte Inc.

BitByte Inc. Balance Sheets as of December 31, 2017, and December 31, 2016

Assets	2017	2016
Cash and marketable securities		
Accounts receivable	$ 15,844	$ 26,103
Inventory	573,228	421,670
Other current assets	3,554	10,007
Total current assets	$592,626	$457,780
Plant and equipment	309,675	205,480
Less: Accumulated depreciation	(91,410)	(48,295)
Net plant and equipment	$218,265	$157,185
Goodwill and other assets	12,689	12,689
Total assets	$823,580	$627,654

Liabilities and Equity	2017	2016
Accounts payable and accurals	$ 157,090	$ 94,13
Notes payable	101,159	59,815
Other current liabilities	—	—
Total current liabilities	$ 258,249	$ 153,95
Long-term debt	—	—
Total liabilities	$ 258,249	$ 153,95
Preferred stock	—	—
Common stock (8,000 shares)	8,000	8,000
Additional paid-in capital	493,231	493,231
Retained earnings	64,100	(27,529)
Less: Treasury stock	—	—
Total common eqiuity	$565,331.00	$473,702.00
Total liabilities and equity	$823,580.00	$627,654.00

Approach The cash flow invested in net working capital during fiscal year 2017 can be computed as the difference between the net working capital observed at the end of fiscal year 2017 and the net working capital observed at the end of fiscal year 2016. Net working capital for a given year can be computed as the difference between total current assets and total current liabilities. The cash flow invested in long-term assets is calculated as the change in long-term assets from the end of fiscal year 2016 to the end of fiscal year 2017. Long-term assets for BitByte include plant and equipment as well as goodwill and other assets. Since depreciation on plant and equipment is a noncash charge, we ignore accumulated depreciation in the calculation.

Solution Net working capital (NWC) for 2016 and 2017 can be computed as follows:

$$NWC_{2016} = \$457,780 - \$153,952 = \$303,828$$
$$NWC_{2017} = \$592,626 - \$258,249 = \$334,377$$

The cash flow invested in net working capital (CFNWC) for 2017 can be computed as:

$$CFNWC_{2017} = \$334,377 - \$303,828 = \$30,549$$

The cash flow invested in long-term assets (CFLTA) for 2017 is the difference in the long-term asset accounts for 2017 and 2016 ignoring accumulated depreciation.

$$CFLTA_{2017} = \$322,364 - \$218,169 = \$104,195$$

BitByte did not make any new investments in goodwill and other assets during the fiscal year; thus, the cash flow invested in long-term assets reflected only $104,195 of new investment in plant and equipment.

$$CFI = CFOA - CFNWC - CFLTA \quad (3.7)$$

Exhibit 3.6 **U.S. Federal Corporate Income Tax Rates for 2016**

The federal corporate marginal tax rate varies from 15 to 39 percent. Generally speaking, smaller companies with lower taxable income have lower tax rates than larger companies with higher taxable incomes. Smaller businesses are given preferential treatment to encourage new business formation.

(1) Corporations' Taxable Income	(2) Pay This Amount on the Base of the Bracket	(3) Marginal Tax Rate: Tax Rate on the Excess Over the Base	(4) Average Tax Rate at Top of Bracket
$0–$50,000	$ 0	15%	15.0%
50,001–75,000	7,500	25	18.3
75,001–100,000	13,750	34	22.3
100,001–335,000	22,250	39	34.0
335,001–10,000,000	113,900	34	34.0
10,000,001–15,000,000	3,400,000	35	34.3
15,000,001–18,333,333	5,150,000	38	35.0
More than 18,333,333	6,416,667	35	35.0

LEARNING BY DOING

APPLICATION 3.3 | The Difference between Average and Marginal Tax Rates

Problem Taxland Corporation has taxable income of $90,000. What is the firm's federal corporate income tax liability? What are the firm's average and marginal tax rates?

Approach Use Exhibit 3.6 to calculate the firm's tax bill. To calculate the average tax rate, divide the total amount of taxes paid by the $90,000 of taxable income. The marginal tax rate is the tax rate paid on the last dollar of taxable income.

Solution

$$\begin{aligned}\text{Tax bill} &= (0.15 \times \$50{,}000) + [0.25 \times (\$75{,}000 - \$50{,}000)] \\ &\quad + [0.34 \times (\$90{,}000 - \$75{,}000)] \\ &= \$7{,}500 + \$6{,}250 + \$5{,}100 \\ &= \$18{,}850\end{aligned}$$

$$\text{Average tax rate} = \$18{,}850/\$90{,}000 = 0.209, \text{ or } 20.9\%$$

$$\text{Marginal tax rate} = 34$$

Summary of Key Equations

Equation	Description	Formula
3.1	Balance sheet identity	Total assets = Total liabilities + Total stockholders' equity
3.2	Net working capital	Net working capital = Total current assets − Total current liabilities
3.3	Income statement equation	Net income = Revenues − Expenses
3.4	Cash flow from operating activity	CFOA = EBIT − Current taxes + Noncash expenses
3.5	Cash flow invested in net working capital	$CFNWC = NWC_{\text{current period}} - NWC_{\text{previous period}}$
3.6	Cash flow invested in long-term assets	$CFLTA = \text{Long-term assets}_{\text{current period}} - \text{Long-term assets}_{\text{previous period}}$
3.7	Cash flow to investors	CFI = CFOA − CFNWC − CFLTA

Self-Study Problems

3.1 The *going concern assumption* of GAAP implies that the firm:

a. Is going under and needs to be liquidated at historical cost.

b. Will continue to operate and its assets should be recorded at historical cost.

c. Will continue to operate and that all assets should be recorded at their cost rather than at their liquidation value.

d. Is going under and needs to be liquidated at liquidation value.

3.2 The Ellicott City Ice Cream Company management has just completed an assessment of the company's assets and liabilities and has obtained the following information. The firm has total current assets worth $625,000 at book value and $519,000 at market value. In addition, its long-term assets include plant and equipment valued at market for $695,000, while their book value is $940,000. The company's total current liabilities are valued at market for $543,000, while their book value is $495,000. Both the book value and the market value of long-term debt are $350,000. If the company's total assets are equal to a market value of $1,214,000 (book value of $1,565,000), what are the book value and market value of its stockholders' equity?

3.3 Depreciation and amortization expenses are:

a. Part of current assets on the balance sheet.

b. After-tax expenses that reduce a firm's cash flows.

c. Long-term liabilities that reduce a firm's net worth.

d. Noncash expenses that cause a firm's after-tax cash flows to exceed its net income.

3.4 You are given the following information about Clarkesville Plumbing Company. Revenues in 2017 totaled $896, depreciation expenses $75, costs of goods sold $365, and interest expenses $54. At the end of the year, current assets were $121 and current liabilities were $107. The company has an average tax rate of 34 percent. Calculate its net income by setting up an income statement.

3.5 The Huntington Rain Gear Company had $633,125 in taxable income in the year ending September 30, 2017. Calculate the company's tax using the tax schedule in Exhibit 3.6.

Solutions to Self-Study Problems

3.1 One of the key assumptions under GAAP is the *going concern assumption,* which states that the firm: **c.** Will continue to operate and that all assets should be recorded at their cost rather than at their liquidation value.

3.2 The book value and market value of stockholders' equity are shown below (in $ thousands):

Assets			Liabilities and Equity		
	Book	**Market**		**Book**	**Market**
Total current assets	$ 625	$ 519	Total current liabilities	$ 495	$ 543
Fixed assets	940	695	Long-term debt	350	350
			Stockholders' equity	720	321
Total assets	$1,565	$1,214	Total liabilities and equity	$1,565	$1,214

3.3 Depreciation and amortization expenses are: **d.** Noncash expenses that cause a firm's after-tax cash flows to exceed its net income.

3.4 Clarkesville's income statement and net income are as follows:

Clarkesville Plumbing Company
Income Statement for the Fiscal Year Ending December 31, 2017

	Amount
Revenues	$896.00
Costs	365.00
EBITDA	$531.00
Depreciation	75.00
EBIT	$456.00
Interest	54.00
EBT	$402.00
Taxes (34%)	136.68
Net income	$265.32

3.5 Huntington's tax bill is calculated as follows:

Tax Rate	Income Taxed at Indicated Rate	Tax
15%	$50,000	$ 7,500
25	75,000 – 50,000	6,250
34	100,000 – 75,000	8,500
39	335,000 – 100,000	91,650
34	633,125 – 335,000	101,363
Total taxes payable		$215,263

Discussion Questions

3.1 What is a major reason for the accounting scandals in the early 2000s? How do firms sometimes attempt to meet Wall Street analysts' earnings projections?

3.2 Why are taxes and the tax code important for managerial decision making?

3.3 Identify the five fundamental principles of GAAP, and explain briefly their importance.

3.4 Explain why firms prefer to use accelerated depreciation methods over the straight-line method for tax purposes.

3.5 What is treasury stock? Why do firms have treasury stock?

3.6 Define book-value accounting and market-value accounting.

3.7 Compare and contrast depreciation expense and amortization expense.

3.8 Why are retained earnings not considered an asset of the firm?

3.9 What is the statement of cash flows, and what is its role?

3.10 How does a firm's cash flow to investors from operating activity differ from net income, and why?

Questions and Problems

Basic

3.1 **Balance sheet:** Given the following information about Elkridge Sporting Goods, Inc., construct a balance sheet for June 30, 2017. On that date the firm had cash and marketable securities of $25,135, accounts receivable of $43,758, inventory of $167,112, net fixed assets of $325,422,

and other assets of $13,125. It had accounts payables of $67,855, notes payables of $36,454, long-term debt of $223,125, and common stock of $150,000. How much retained earnings did the firm have?

3.2 Inventory accounting: What is the difference between FIFO and LIFO accounting.

3.3 Inventory accounting: Explain how the choice of FIFO versus LIFO can affect a firm's balance sheet and income statement.

3.4 Market-value accounting: How does the use of market-value accounting help managers?

3.5 Working capital: Laurel Electronics reported the following information at its annual meeting: The company had cash and marketable securities worth $1,235,455, accounts payables worth $4,159,357, inventory of $7,121,599, accounts receivables of $3,488,121, short-term notes payable worth $1,151,663, and other current assets of $121,455. What is the company's net working capital?

3.6 Working capital: The financial information for Laurel Electronics referred to in Problem 3.5 is all at book value. Suppose marking to market reveals that the market value of the firm's inventory is 20 percent below its book value, its receivables are 25 percent below their book value, and the market value of its current liabilities is identical to the book value. What is the firm's net working capital using market values? What is the percentage difference in net working capital using market versus book values?

3.7 Income statement: The Oakland Mills Company has disclosed the following financial information in its annual reports for the period ending March 31, 2017: sales of $1.45 million, cost of goods sold of $812,500, depreciation expenses of $175,000, and interest expenses of $89,575. Assume that the firm has an average tax rate of 35 percent. What is the company's net income? Set up an income statement to answer the question.

3.8 Cash flows: Describe the organization of the statement of cash flows.

3.9 Cash flows: During 2017, Towson Recording Company increased its investment in marketable securities by $36,845, funded fixed-assets acquisitions of $109,455, and had marketable securities of $14,215 mature. What is the net cash used in investing activities?

3.10 Cash flows: Caustic Chemicals management identified the following cash flows as significant in its year-end meeting with analysts: During the year, Caustic repaid existing debt of $312,080 and raised additional debt capital of $650,000. It also repurchased stock in the open market for a total of $45,250. What is the net cash provided by financing activities?

3.11 Cash flows: Identify and describe the noncash expenses that a firm may incur.

3.12 Cash flows: Given the data for Oakland Mills Company in Problem 3.7, compute the cash flows to investors from operating activity.

3.13 Cash flows: Hillman Corporation reported current assets of $3,495,055 on December 31, 2017, and current assets of $3,103,839 on December 31, 2016. Current liabilities for the firm were $2,867,225 and $2,760,124 at the end of 2017 and 2016, respectively. Compute the cash flow invested in net working capital at Hillman Corporation during 2017.

3.14 Cash flows: Del Bridge Construction had long-term assets before depreciation of $990,560 on December 31, 2016, and $1,211,105 on December 31, 2017. How much cash flow was invested in long-term assets by Del Bridge during 2017?

3.15 Tax: Define average tax rate and marginal tax rate.

3.16 Tax: What is the relevant tax rate to use when making financial decisions? Explain why.

3.17 Tax: Manz Property Management Company announced that in the year ended June 30, 2017, its earnings before taxes amounted to $1,478,936. Calculate its taxes using Exhibit 3.6.

Intermediate

3.18 Balance sheet: Tim Dye, the CFO of Blackwell Automotive, Inc., is putting together this year's financial statements. He has gathered the following balance sheet information: The firm had a cash balance of $23,015, accounts payable of $163,257, common stock of $313,299, retained earnings of $512,159, inventory of $212,444, goodwill and other assets equal to $78,656, net plant and equipment of $711,256, and short-term notes payable of $21,115. It also had accounts receivable of $141,258 and other current assets of $11,223. How much long-term debt does Blackwell Automotive have?

3.19 Working capital: Mukhopadhya Network Associates has a current ratio of 1.60, where the current ratio is defined as follows: Current ratio = Current assets/Current liabilities. The firm's current assets are equal to $1,233,265, its accounts payables are $419,357, and its notes payables are $351,663. Its inventory is currently at $721,599. The company plans to raise funds in the short-term debt market and invest the entire amount in additional inventory. How much can notes payable increase without the current ratio falling below 1.50?

3.20 Market value: Reservoir Bottling Company reported the following information at the end of the year. Total current assets are worth $237,513 at book value and $219,344 at market value. In addition, plant and equipment have a market value of $343,222 and a book value of $362,145. The company's total current liabilities are valued at market for $134,889 and have a book value of $129,175. Both the book value and the market value of long-term debt are $144,000. If the company's total assets have a market value of $562,566 and a book value of $599,658, what is the difference between the book value and market value of its stockholders' equity?

3.21 Income statement: Nimitz Rental Company provided the following information to its auditors. For the year ended March 31, 2017, the company had revenues of $878,412, general and administrative expenses of $352,666, depreciation expenses of $131,455, leasing expenses of $108,195, and interest expenses equal to $78,122. If the company's average tax rate is 34 percent, what is its net income after taxes?

3.22 Income statement: Sosa Corporation recently reported an EBITDA of $31.3 million and net income of $9.7 million. The company had $6.8 million in interest expense, and it's average corporate tax rate was 35 percent. What was its depreciation and amortization expense?

3.23 Income statement: Fraser Corporation has announced that its net income for the year ended June 30, 2017, was $1,353,412. The company had EBITDA of $4,967,855, and its depreciation and amortization expense was equal to $1,112,685. The company's average tax rate is 34 percent. What was its interest expense?

3.24 Income Statement: For its most recent fiscal year, Carmichael Hobby Shop recorded EBITDA of $512,725.20, EBIT of $362,450.20, zero interest expense, and cash flow to investors from operating activity of $348,461.25. Assuming there are no noncash revenues recorded on the income statement, what is the firm's net income after taxes?

3.25 Retained earnings: Columbia Construction Company earned $451,888 during the year ended June 30, 2017. After paying out $225,794 in dividends, the balance went into retained earnings. If the firm's total retained earnings were $846,972 at the end of fiscal year 2017, what were the retained earnings on its balance sheet on July 1, 2016?

3.26 Cash flows: Refer to the information given in Problem 3.21. What is the cash flow from operating activity for Nimitz Rental?

3.27 Tax: Mount Hebron Electrical Company's financial statements indicated that the company had earnings before interest and taxes of $718,323. The interest rate on its $850,000 debt was 8.95 percent. Calculate the taxes the company is likely to owe. What are the marginal and average tax rates for this company?

Advanced

3.28 The Centennial Chemical Corporation announced that, for the period ending March 31, 2017, it had earned income after taxes of $2,768,028.25 on revenues of $13,144,680. The company's costs (excluding depreciation and amortization) amounted to 61 percent of sales, and it had interest expenses of $392,168. What is the firm's depreciation and amortization expense if its average tax rate is 34 percent?

3.29 Eau Claire Paper Mill, Inc., had, at the beginning of the current fiscal year, April 1, 2016, retained earnings of $323,325. During the year ended March 31, 2017, the company produced net income after taxes of $713,445 and paid out 45 percent of its net income as dividends. Construct a statement of retained earnings and compute the year-end balance of retained earnings.

3.30 Menomonie Casino Company earned $23,458,933 before interest and taxes for the fiscal year ending March 31, 2017. If the casino had interest expenses of $1,645,123, calculate its tax obligation using Exhibit 3.6. What are the marginal and the average tax rates for this company?

3.31 Vanderheiden Hog Products Corp. provided the following financial information for the quarter ending June 30, 2017:

Net income: $189,425
Depreciation and amortization: $63,114
Increase in receivables: $62,154
Increase in inventory: $57,338
Increase in accounts payable: $37,655
Decrease in other current assets: $27,450

What is this firm's cash flow from operating activities during this quarter?

3.32 Cash flows: Analysts following the Tomkovick Golf Company were given the following balance sheet information for the years ended June 30, 2017, and June 30, 2016:

Assets	**2017**	**2016**
Cash and marketable securities	$ 33,411	$ 16,566
Accounts receivable	260,205	318,768
Inventory	423,819	352,740
Other current assets	41,251	29,912
Total current assets	$ 758,686	$ 717,986
Plant and equipment	1,931,719	1,609,898
Less: Accumulated depreciation	(419,044)	(206,678)
Net plant and equipment	$1,512,675	$1,403,220
Goodwill and other assets	382,145	412,565
Total assets	$2,653,506	$2,533,771

Liabilities and Equity	**2017**	**2016**
Accounts payable and accruals	$ 378,236	$ 332,004
Notes payable	14,487	7,862
Accrued income taxes	21,125	16,815
Total current liabilities	$ 413,848	$ 356,681
Long-term debt	679,981	793,515
Total liabilities	$1,093,829	$1,150,196
Preferred stock	—	—
Common stock (10,000 shares)	10,000	10,000
Additional paid-in capital	975,465	975,465
Retained earnings	587,546	398,110
Less: Treasury stock	(13,334)	—
Total common equity	$1,559,677	$1,383,575
Total liabilities and equity	$2,653,506	$2,533,771

In addition, it was reported that the company had a net income of $3,155,848 and that depreciation expenses were equal to $212,366 during 2017. Assume amortization expense was $0 in 2017.

a. Construct a 2017 cash flow statement for this firm.

b. Calculate the net cash provided by operating activities for the statement of cash flows.

c. What is the net cash used in investing activities?

d. Compute the net cash provided by financing activities.

3.33 **Cash flows:** Based on the financial statements for Tomkovick Golf Company in Problem 3.32, compute the cash flow invested in net working capital and the cash flow invested in long-term assets that you would use in a calculation of the cash flow to investors for 2017.

Sample Test Problems

3.1 What is the matching principle, and how can it cause accounting expenses to differ from actual cash outflows?

3.2 Wolf Pack Enterprises has total current assets of $346,002 and fixed assets of $476,306. The company also has long-term debt of $276,400, $100,000 in its common stock account, and retained earnings of $187,567. What is the value of its total current liabilities?

3.3 What is the difference between a book-value balance sheet and a market-value balance sheet? Which provides better information to investors and management?

3.4 ACME Corporation had revenues of $867,030. It also had expenses (excluding depreciation) of $356,240, depreciation of $103,456, and interest expense of $52,423. What was the company's net income after taxes if its average tax rate was 40 percent?

3.5 True Blue Company increased its investments in marketable securities by $323,370 and paid $1,220,231 for new fixed assets during 2017. The company also repaid $779,200 of existing long-term debt while raising $913,455 of new debt capital. In addition, True Blue had a net cash inflow of $345,002 from the sale of fixed assets, and repurchased stock in the open markets for a total of $56,001. What is the net cash used in long-term investing activities by True Blue? What is the net cash provided by the company's financing activities?

3.6 Sun Devil Corporation reported EBITDA of $7,300,125 and net income of $3,328,950 for the fiscal year ended December 31, 2017. During the same period, the company had $1,155,378 in interest expense, $1,023,285 in depreciation and amortization expense, and an average corporate tax rate of 35 percent. What was the cash flow to investors from operating activity during 2017?

Figure 4.1

	Target ($ millions)	Wal-Mart ($ millions)
Total sales	$73,785	$482,130
Net income	$ 3,363	$ 14,694

EXHIBIT 4.1 **Common-Size Balance Sheets for Diaz Manufacturing on December 31 ($ millions)**

In common-size balance sheets, such as those in this exhibit, each asset account and each liability and equity account are expressed as a percentage of total assets. Common-size statements allow financial analysts to compare firms that are different in size and to identify trends within a single firm over time.

	2017		2016		2015	
		% of Assets		% of Assets		% of Assets
Assets						
Cash and marketable securities	$ 288.5	15.3	$ 16.6	1.1	$ 8.2	0.6
Accounts receivable	306.2	16.2	268.8	18.0	271.5	19.4
Inventories	423.8	22.4	372.7	24.9	400.0	28.6
Other current assets	21.3	1.1	29.9	2.0	24.8	1.8
Total current assets	$1,039.8	55.0	$ 688.0	46.1	$ 704.5	50.4
Plant and equipment (net)	399.4	21.1	394.2	26.4	419.6	30.0
Goodwill and other assets	450.0	23.8	411.6	27.6	273.9	19.6
Total assets	$1,889.2	100.0	$1,493.8	100.0	$1,398.0	100.0
Liabilities and Stockholders' Equity:						
Accounts payable and accruals	$ 349.3	18.5	$ 325.0	21.8	$ 395.0	28.3
Notes payable	10.5	0.6	4.2	0.3	14.5	1.0
Accrued income taxes	18.0	1.0	16.8	1.1	12.4	0.9
Total current liabilities	$ 377.8	20.0	$ 346.0	23.2	$ 421.9	30.2
Long-term debt	574.0	30.4	305.6	20.5	295.6	21.1
Total liabilities	$ 951.8	50.4	$ 651.6	43.6	$ 717.5	51.3
Common stock (54,566,054 shares)	0.5	0.0	0.5	0.0	0.5	0.0
Additional paid-in capital	892.4	47.2	892.4	59.7	892.4	63.8
Retained earnings	67.8	3.6	(50.7)	(3.4)	(155.8)	(11.1)
Less: Treasury stock	(23.3)	(1.2)	—	—	(56.6)	(4.0)
Total stockholders' equity	$ 937.4	49.6	$ 842.2	56.4	$ 680.5	48.7
Total liabilities and equity	$1,889.2	100.0	$1,493.8	100.0	$1,398.0	100.0

EXHIBIT 4.2 **Common-Size Income Statements for Diaz Manufacturing for Fiscal Years Ending December 31 ($ millions)**

Common-size income statements express each account as a percentage of net sales. These statements allow financial analysts to better compare firms of different sizes and to analyze trends in a single firm's income statement accounts over time.

	2017		2016		2015	
		% of Net Sales		% of Net Sales		% of Net Sales
Net sales	$1,563.7	100.0	$1,386.7	100.0	$1,475.1	100.0
Cost of goods sold	1,081.1	69.1	974.8	70.3	1,076.3	73.0
Selling and administrative expenses	231.1	14.8	197.4	14.2	205.7	13.9
Earnings before interest, taxes, depreciation, and amortization (EBITDA)	$ 251.5	16.1	$ 214.5	15.5	$ 193.1	13.1
Depreciation	83.1	5.3	75.3	5.4	71.2	4.8
Earnings before interest and taxes (EBIT)	$ 168.4	10.8	$ 139.2	10.0	$ 121.9	8.3
Interest expense	5.6	0.4	18.0	1.3	27.8	1.9
Earnings before taxes (EBT)	$ 162.8	10.4	$ 121.2	8.7	$ 94.1	6.4
Taxes	44.3	2.8	16.1	1.2	27.9	1.9
Net income	$ 118.5	7.6	$ 105.1	7.6	$ 66.2	4.5
Dividends	—		—		—	
Addition to retained earnings	$ 118.5		$ 105.1		$ 66.2	

Figure 4.2

Firm	ROE Calculation	ROE
A	$5/$25	0.20, or 20%
B	$50/$5,000	0.01, or 1%

$$\text{Current ratio} = \frac{\text{Current assets}}{\text{Current liabilities}} \tag{4.1}$$
$$= \frac{\$1{,}039.8}{\$377.8}$$
$$= 2.75$$

EXHIBIT 4.3 **Ratios for Time-Trend Analysis for Diaz Manufacturing for Fiscal Years Ending December 31**

Comparing how financial ratios, such as these ratios for Diaz Manufacturing, change over time enables financial analysts to identify trends in company performance.

Financial Ratio	2017	2016	2015
Liquidity Ratios:			
Current ratio	2.75	1.99	1.67
Quick ratio	1.63	0.91	0.72
Efficiency Ratios:			
Inventory turnover	2.55	2.62	2.69
Days' sales in inventory	143.14	139.31	135.69
Accounts receivable turnover	5.11	5.16	5.43
Days' sales outstanding	71.43	70.74	67.22
Total asset turnover	0.83	0.93	1.06
Fixed asset turnover	3.92	3.52	3.52
Leverage Ratios:			
Total debt ratio	0.50	0.44	0.51
Debt-to-equity ratio	1.02	0.77	1.05
Equity multiplier	2.02	1.77	2.05
Times interest earned	30.07	7.73	4.38
Cash coverage	44.91	11.92	6.95
Profitability Ratios:			
Gross profit margin	30.86%	29.70%	27.04%
Operating profit margin	10.77%	10.04%	8.26%
Net profit margin	7.58%	7.58%	4.49%
EBIT return on assets	8.91%	9.32%	8.72%
Return on assets	6.27%	7.04%	4.74%
Return on equity	12.64%	12.48%	9.73%
Market-Value Indicators:			
Price-earnings ratio	22.40	18.43	14.29
Earnings per share	$ 2.17	$ 1.93	$ 1.21
Market-to-book ratio	2.83	1.63	1.39

Note: Numbers may not add up because of rounding.

$$\text{Quick ratio} = \frac{\text{Current assets} - \text{Inventory}}{\text{Current liabilities}} \qquad (4.2)$$

$$= \frac{\$1{,}039.8 - \$423.8}{\$377.8}$$

$$= 1.63$$

DECISION MAKING

EXAMPLE 4.1 | The Liquidity Paradox

Situation You are asked by your boss whether Wal-Mart or H&R Block is more liquid. You have the following information:

	Wal-Mart	H&R Block
Current ratio	0.93	1.18
Quick ratio	0.24	1.18

You also know that Wal-Mart carries a large inventory and that H&R Block is a service firm that specializes in income-tax preparation. Which firm is more liquid? Your boss asks you to explain the reasons for your answers and also to explain why H&R Block's current and quick ratios are the same.

Decision Wal-Mart is much less liquid than H&R Block. The difference between the quick ratios—0.24 versus 1.18—pretty much tells the story. Inventory is the least liquid of all the current assets. Because H&R Block does not manufacture or sell goods, it has no inventory; hence, the current and quick ratios are equal. Wal-Mart has a lot of inventory relative to the rest of its current assets, and that explains the large numerical difference between the current and quick ratios.

$$\text{Inventory turnover} = \frac{\text{Cost of goods sold}}{\text{Inventory}} \tag{4.3}$$
$$= \frac{\$1{,}081.1}{\$423.8}$$
$$= 2.55$$

$$\text{Days' sales in inventory} = \frac{365 \text{ days}}{\text{Inventory turnover}} \tag{4.4}$$
$$= \frac{365 \text{ days}}{2.55}$$
$$= 143.14 \text{ days}$$

$$\text{Accounts receivable turnover} = \frac{\text{Net sales}}{\text{Accounts receivable}} \tag{4.5}$$
$$= \frac{\$1{,}563.7}{\$306.2}$$
$$= 5.11$$

LEARNING BY DOING

APPLICATION 4.1 | Alternative Calculations for Efficiency Ratios

Problem For Diaz Manufacturing, compute inventory turnover during 2017 using the average inventory. Then compare that value with 2.55, the turnover ratio computed using Equation 4.3. Why do the two values differ?

Approach Use the alternative calculation described above. In comparing the two values, you should consider fluctuations in inventory over time.

Solution

1. $$\text{Average inventory} = \frac{\text{Beginning inventory} + \text{Ending inventory}}{2}$$
$$= \frac{\$372.7 + \$423.8}{2}$$
$$= \$398.3$$

2. $$\text{Inventory turnover} = \frac{\text{Cost of goods sold}}{\text{Average inventory}}$$
$$= \frac{\$1{,}081.1}{\$398.3}$$
$$= 2.71$$

The 2017 inventory turnover computed with average inventory, 2.71 times, is slightly higher than 2.55 because the inventory increased during the year.

$$\text{Days' sales outstanding} = \frac{365 \text{ days}}{\text{Accounts receivable turnover}} \tag{4.6}$$
$$= \frac{365 \text{ days}}{5.11}$$
$$= 71.43 \text{ days}$$

$$\text{Total assets turnover} = \frac{\text{Net sales}}{\text{Total assets}} \tag{4.7}$$
$$= \frac{\$1{,}563.7}{\$1{,}889.2}$$
$$= 0.83$$

$$\text{Fixed assets turnover} = \frac{\text{Net sales}}{\text{Net fixed assets}} = \frac{\$1{,}563.7}{\$3994} = 3.92 \quad (4.8)$$

DECISION MAKING

EXAMPLE 4.2 | Ranking Firms by Fixed Asset Turnover

Situation Different industries use different amounts of fixed assets to generate their revenues. For example, the airline industry is capital intensive, with large investments in airplanes, whereas firms in service industries use more human capital (people) and have very little invested in fixed assets. As a financial analyst, you are given the following fixed asset turnover ratios: 1.77, 4.13, and 10.35. You must decide which ratios match up with three firms: Delta Air Lines, H&R Block, and Wal-Mart. Make this decision, and explain your reasoning.

Decision At the extremes, Delta is a capital-intensive firm, and H&R Block is a service firm. We would expect firms with large investments in fixed assets (Delta) to have lower asset turnover than service-industry firms, which have few fixed assets. Wal-Mart is the middle-ground firm, with fixed asset holdings primarily in stores and land. Thus, the firms and their respective fixed asset turnover ratios are Delta = 1.77, Wal-Mart = 4.13, and H&R Block = 10.35.

$$\text{Total debt ratio} = \frac{\text{Total debt}}{\text{Total assets}} = \frac{\$951.8}{\$1{,}889.2} = 0.50 \quad (4.9)$$

$$\text{Debt-to-equity ratio} = \frac{\text{Total debt}}{\text{Total equity}} = \frac{\$951.8}{\$937.4} = 1.02 \quad (4.10)$$

LEARNING BY DOING

APPLICATION 4.2 | Finding a Total Debt Ratio

Problem A firm's debt-to-equity ratio is 0.5. What is the firm's total debt ratio?

Approach Use the equation that relates the total debt ratio to the debt-to-equity ratio.

Solution

$$\begin{aligned}\text{Total debt ratio} &= \frac{\text{Debt-to-equity ratio}}{1 + \text{Debt-to-equity ratio}} \\ &= \frac{0.5}{1 + 0.5} \\ &= 0.33\end{aligned}$$

LEARNING BY DOING

APPLICATION 4.3 | Solving for an Unknown Using the Debt-to-Equity Ratio

Problem You are given the following information about Delta Air Lines' year-end balance sheet for 2015. The firm's debt-to-equity ratio is 3.90, and its total equity is $10.85 billion. Determine the book (accounting) values for Delta Air Lines' total debt and total assets.

Approach We know that the debt-to-equity ratio is 3.90 and that total equity is $10.85 billion. We also know that the debt-to-equity ratio (Equation 4.10) is equal to total debt divided by total equity, and we can use this information to solve for total debt. Once we have a figure for total debt, we can use the balance sheet identity to solve for total assets.

Solution

$$\begin{aligned}\text{Total debt} &= \text{Debt-to-equity ratio} \times \text{Total equity} \\ &= 3.90 \times \$10.85 \text{ billion} \\ &= \$42.32 \text{ billion} \\ \text{Total assets} &= \text{Total debt} + \text{Total equity} \\ &= \$42.32 \text{ billion} + \$10.85 \text{ billion} \\ &= \$53.17 \text{ billion}\end{aligned}$$

$$\begin{aligned}\text{Equity multiplier} &= \frac{\text{Total assets}}{\text{Total equity}} \\ &= \frac{\$1{,}889.2}{\$937.4} \\ &= 2.02\end{aligned} \tag{4.11}$$

$$\begin{aligned}\text{Times interest earned} &= \frac{\text{EBIT}}{\text{interest expense}} \\ &= \frac{\$168.4}{\$5.6} \\ &= 30.07\end{aligned} \tag{4.12}$$

$$\text{Cash coverage} = \frac{\text{EBITDA}}{\text{interest expense}} \tag{4.13}$$
$$= \frac{\$251.5}{\$5.6}$$
$$= 44.91$$

$$\text{Gross profit margin} = \frac{\text{Net sales} - \text{Cost of goods sold}}{\text{Net sales}} \tag{4.14}$$
$$= \frac{\$1{,}563.7 - \$1{,}081.1}{\$1{,}563.7}$$
$$= 0.3086, \text{ or } 30.86\%$$

$$\text{Operating profit margin} = \frac{\text{EBIT}}{\text{Net sales}} \tag{4.15}$$
$$= \frac{\$168.4}{\$1{,}563.7}$$
$$= 0.1077, \text{ or } 10.77\%$$

$$\text{Net profit margin} = \frac{\text{Net income}}{\text{Net sales}} \tag{4.16}$$
$$= \frac{\$118.5}{\$1{,}563.7}$$
$$= 0.0758, \text{ or } 7.58\%$$

$$\text{EBIT return on assets(EROA)} = \frac{\text{EBIT}}{\text{Total assets}} \tag{4.17}$$
$$= \frac{\$168.4}{\$1{,}889.2}$$
$$= 0.0891, \text{ or } 8.91\%$$

$$\text{Return on assets (ROA)} = \frac{\text{Net income}}{\text{Total assets}} \tag{4.18}$$
$$= \frac{\$118.5}{\$1{,}889.2}$$
$$= 0.0627, \text{ or } 6.27\%$$

$$\text{Return on equity (ROE)} = \frac{\text{Net income}}{\text{Total equity}} \tag{4.19}$$
$$= \frac{\$118.5}{\$937.4}$$
$$= 0.1264, \text{ or } 12.64\%$$

LEARNING BY DOING

APPLICATION 4.4 | Alternative Calculations for EROA and ROE Ratios

Problem Calculate the EROA and ROE for Diaz Manufacturing in 2017 using average balance sheet values and compare the results with the calculations based on Equations 4.17 and 4.19.

Approach First find average values for the asset and equity accounts using data from Exhibit 4.1. Then use these values to calculate the EROA and ROE. In explaining why some analysts might prefer the alternative calculation, consider possible fluctuations of assets or equity over time.

Solution

$$\text{Average asset or equity value} = \frac{\text{Beginnning value} + \text{Ending value}}{2}$$
$$\text{Average asset value} = \frac{\$1{,}493.8 + \$1{,}889.2}{2}$$
$$= \$1{,}691.5$$
$$\text{Average equity value} = \frac{\$842.2 + \$937.4}{2}$$
$$= \$889.8$$
$$\text{EROA} = \frac{\text{EBIT}}{\text{Total assets}} = \frac{\$168.4}{\$1{,}691.5}$$
$$= 0.0996, \text{ or } 9.96\%$$
$$\text{ROE} = \frac{\text{Net income}}{\text{Total equity}} = \frac{\$118.5}{\$889.8}$$
$$= 0.1332, \text{ or } 13.32\%$$

Both EROA (9.96 percent versus 8.91 percent) and ROE (13.32 percent versus 12.64 percent) are higher when the average values are used. The reason is that Diaz's total assets grew from $1,493.8 million in 2016 to $1,889.2 million in 2017 and its equity grew from $842.2 million to $937.4 million during the same period.

$$\text{Earning per share} = \frac{\text{Net income}}{\text{Shares outstanding}} \tag{4.20}$$
$$= \frac{\$118{,}500{,}000}{54{,}566{,}054} = \$2.17 \text{ per share}$$

$$\text{Price-earnings ratio} = \frac{\text{Price per share}}{\text{Earnings per share}} \tag{4.21}$$
$$= \frac{\$48.61}{\$2.17} = 22.4$$

$$\text{Market-to-book ratio} = \frac{\text{Market value or equity per share}}{\text{Book value of equity per share}} \tag{4.22}$$
$$= \frac{\$48.61}{\$937.4/54.566}$$
$$= \frac{\$48.61}{\$17.18} = 2.83$$

$$\text{ROA} = \text{Net profit margin} \times \text{Total asset turnover} \tag{4.23}$$

EXHIBIT 4.4 **Two Basic Strategies to Earn a Higher ROA[a]**

To maximize a firm's ROA, management can focus more on achieving high profit margins or on achieving high asset turnover. High-end retailers like Tiffany & Co. and Burberry Group plc focus more on achieving high profit margins. In contrast, grocery and discount stores like Whole Foods Market and Wal-Mart tend to focus more on achieving high asset turnover because competition limits their ability to achieve very high profit margins.

Company	Asset Turnover	×	Profit Margin (%)	=	ROA (%)
High Profit Margin:					
Tiffany & Co.	0.80		11.30		9.04
Burberry Group plc	1.09		12.33		13.44
High Turnover:					
Whole Foods Market	2.48		3.22		7.99
Wal-Mart Stores	2.42		3.05		7.38

[a]Ratios are calculated using financial results for the fiscal year ending closest to December 2015.

$$\text{ROE} = \text{ROA} \times \text{Equity multiplier} \tag{4.24}$$

$$\text{ROE} = \text{Net profit margin} \times \text{Total asset turnover} \times \text{Equity multiplier} \tag{4.25}$$

$$\text{ROE} = \frac{\text{Net income}}{\text{Net sales}} \times \frac{\text{Net sales}}{\text{Total asets}} \times \frac{\text{Total assets}}{\text{Total equity}} \tag{4.26}$$

Figure 4.3

DuPont Ratios	Firm	Industry
ROE	8%	16%
ROA	4%	8%
Equity multiplier	2	2
Net profit margin	8%	16%
Asset turnover	0.5	0.5

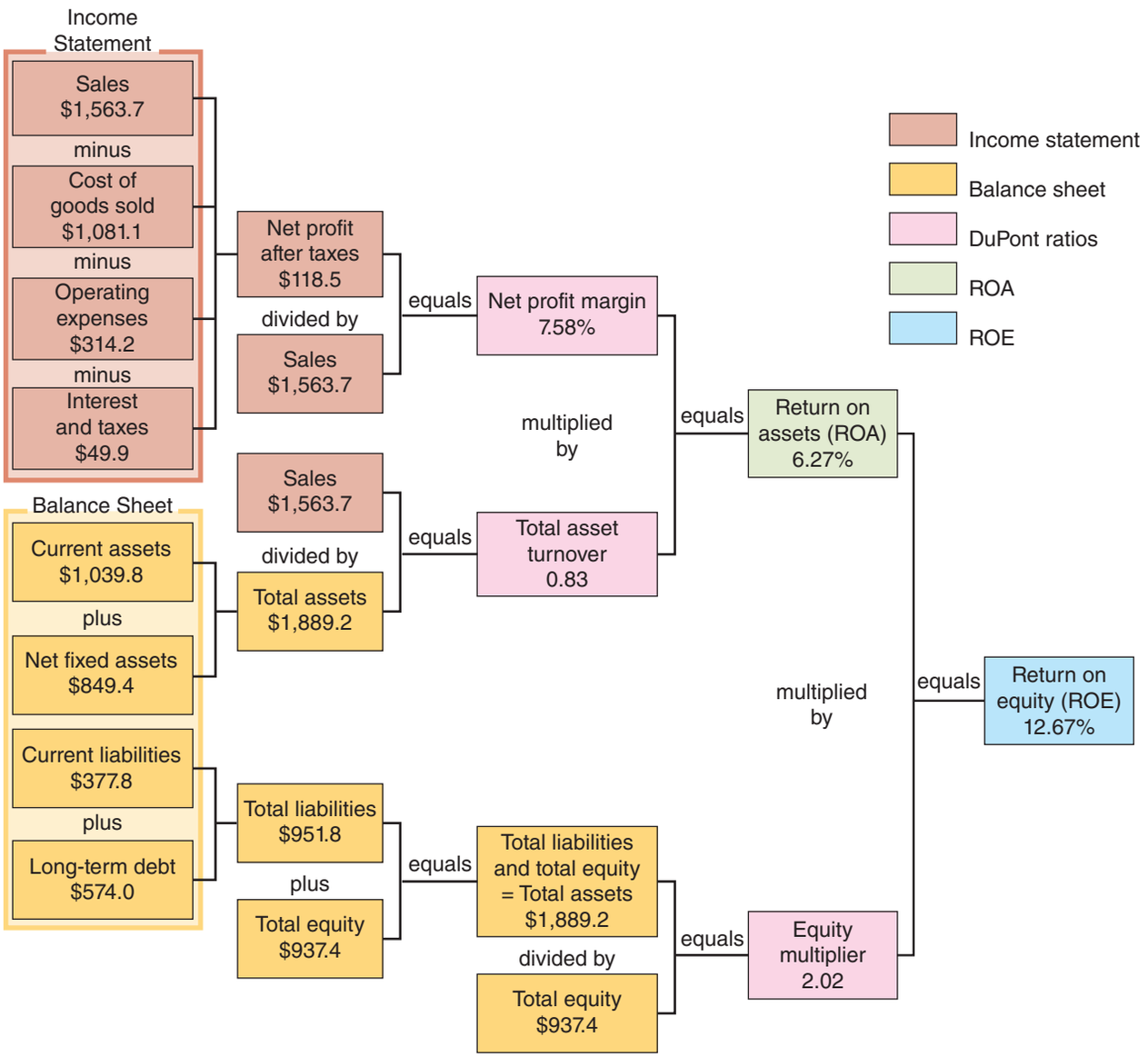


EXHIBIT 4.5 **Relations in the DuPont System of Analysis for Diaz Manufacturing in 2017 ($ millions)**

The diagram shows how the three key DuPont ratios are linked together and to the firm's balance sheet and income statement. Numbers in the exhibit are in millions of dollars and represent 2017 data from Diaz Manufacturing. The ROE of 12.67 percent differs from the 12.64 percent in Exhibit 4.3 due to rounding.

EXHIBIT 4.6 **Peer Group Ratios for Diaz Manufacturing**

Peer group analysis is one way to establish benchmarks for a firm. Ideally, a firm's peer group is made up of firms that are direct competitors and are about the same size. The exhibit shows the average financial ratios for public companies that make up the peer group for Diaz Manufacturing for 2015, 2016, and 2017.

	2017	2016	2015
Liquidity Ratios:			
Current ratio	2.10	2.20	2.10
Quick ratio	1.50	1.60	1.50
Efficiency Ratios:			
Inventory turnover	5.40	5.30	5.20
Days' sales in inventory	67.59	68.87	70.19
Accounts receivable turnover	4.90	4.20	4.10
Days' sales outstanding	76.70	89.80	90.00
Total asset turnover	0.87	0.90	0.80
Fixed asset turnover	3.50	3.30	2.40
Leverage Ratios:			
Total debt ratio	0.18	0.11	0.21
Debt-to-equity ratio	0.40	0.20	0.50
Equity multiplier	2.02	1.77	2.05
Times interest earned	7.00	5.60	1.60
Cash coverage	7.50	8.20	1.30
Profitability Ratios:			
Gross profit margin	26.80%	24.10%	19.20%
Operating profit margin	12.00%	6.90%	2.70%
Net profit margin	10.74%	3.30%	0.10%
Return on assets	9.34%	3.30%	0.80%
Return on equity	13.07%	7.00%	1.00%
Market-Value Indicators:			
Price-earnings ratio	18.10	38.40	44.60
Earnings per share	$1.65	$3.85	$3.78
Market-to-book ratio	2.84	1.82	1.64

EXHIBIT 4.7 **Peer Group Analysis for Diaz Manufacturing in 2017**

Examining the differences between the ratios of a firm and its peer group is a good way to spot areas that require further analysis.

	(1) Diaz Ratio	(2) Peer Group Ratio	(3) Difference (Column 1 – Column 2)
DuPont Ratios:			
Return on equity (%)	12.64	13.07	(0.43)
Return on assets (%)	6.27	9.34	(3.07)
Equity multiplier (%)	2.02	1.40	0.62
Net profit margin (%)	7.58	10.74	(3.16)
Total asset turnover	0.83	0.87	(0.04)
Asset Ratios:			
Current ratio	2.75	2.10	0.65
Fixed asset turnover	3.92	3.50	0.42
Inventory turnover	2.55	5.40	(2.85)
Accounts receivable turnover	5.11	4.90	0.21
Profit Margins:			
Gross profit margin (%)	30.86	26.80	4.06
Operating margin (%)	10.77	12.00	(1.23)
Net profit margin (%)	7.58	10.74	(3.16)

APPLICATION 4.5 | Ron's Jewelry Store and the Missing Data

LEARNING BY DOING

Problem Ron Roberts has owned and managed a profitable jewelry business in San Diego County for the past five years. He believes his jewelry store is one of the best managed in the county, and he is considering opening several new stores.

When Ron started the store, he supplied all the equity financing himself and financed the rest with personal loans from friends and family members. To open more stores, Ron needs a bank loan. The bank will want to examine his financial statements and know something about the competition he faces.

Ron has asked his brother-in-law, Dennis O'Neil, a CPA, to analyze the financials. Ron has also gathered some financial information about a company he considers the chief competition in the San Diego County market. The competitor has been in business for 25 years, has a number of stores, and is widely admired for its owners' management skills. Dennis organizes the available information in the following table:

Financial Ratio/Data	Ron's Store	Competitor
Net sales ($ thousands)	$240	$300
Net income ($ thousands)	$ 6	—
ROE	13.13%	—
Net profit margin	—	5.84%
Asset turnover	1.5	1.5
Equity multiplier	—	1.5
Debt-to-equity ratio	2.5	—

Calculate the missing values for the financial data above.

Approach Use the ratio equations discussed in the text to calculate the missing financial ratios for both Ron's store and the competitor.

Solution

Ron's jewelry store:

1. Net profit margin $= \dfrac{\text{Net income}}{\text{Net sales}} = \dfrac{\$6}{\$240} = 0.025$, or 2.5%
2. Equity multipier = 1 + Debt-to-equity ratio = 1 + 2.5 = 3.5

Competitor:

1. Net income = Net profit margin × Net sales = 0.0584 × $300 = $17.52
2. ROE = Net profit margin × Total asset turnover × Equity multiplier
   = 0.0584 × 1.5 × 1.5 = 0.1314, or 13.14%
3. Debt-to-equity ratio $= \dfrac{\text{Total debt}}{\text{Total equity}} = \dfrac{\$66.82}{\$133.1} = 0.50$

   (a) Total equity $= \dfrac{\text{Net income}}{\text{Net income/Total equity}} = \dfrac{\$17.5}{0.1314} = \$133.18$

   (b) Total assets $= \dfrac{\text{Net sales}}{\text{Total asset turnover}} = \dfrac{\$300}{1.5} = \$200.00$

   (c) Total debt = Total assets − Total equity = $200.00 − $133.18 = $66.82

DECISION MAKING

EXAMPLE 4.3 | Ron's Jewelry Store and the DuPont Analysis

Situation Let's continue with our analysis of Ron's jewelry store, introduced in Learning by Doing Application 4.5. Brother-in-law Dennis has been asked to analyze the company's financials. He decides to use the DuPont system of analysis as a framework. He arranges the critical information as follows:

Financial Ratios	Ron's Store	Competitor
ROE	13.13%	13.14%
ROA	3.75%	8.76%
Net profit margin	2.50%	5.84%
Asset turnover	1.5	1.5
Equity multiplier	3.5	1.5
Debt-to-equity ratio	2.5	0.5
Net sales ($ thousands)	$240	$300
Net income ($ thousands)	$ 6.0	$ 17.5

Given the above financial ratios, what recommendations should Dennis make regarding Ron's jewelry store and its management?

Decision The good news is that Ron is able to earn about the same ROE as his major competitor. Unfortunately for Ron, it's pretty much downhill from there. Turning to the first two DuPont system ratios, we can see that Ron's ROA of 3.75 percent is much lower than his major competitor's ROA of 8.76 percent. Ron's business is also very highly leveraged, with an equity multiplier of 3.5 times, compared with 1.5 times for the competitor. In fact, the only reason Ron's ROE is comparable to the competitor's is the high leverage. Ron's debt-to-equity ratio is 2.5 whereas the competitor's is only 0.5.

Breaking the ROA into its components, we find that Ron's asset turnover ratio is the same as the competitor's, 1.5. However, the profitability of Ron's store is extremely poor as measured by the firm's net profit margin of 2.50 percent, compared with the competitor's margin of 5.84 percent. One possible explanation is that to stimulate sales and maintain asset turnover, Ron has been selling his merchandise at too low a price.

In summary, Ron's jewelry store is not well managed. Ron needs to either increase his net profit margin or increase his inventory turnover to bring his ROA into line with that of his major competitor. Ron may also need to reduce his dependence on financial leverage, but it makes sense to review interest coverage ratios before deciding whether he should do so.

Summary of Key Equations

Equation	Description	Formula
4.1	Liquidity Ratio	$\text{Current ratio} = \dfrac{\text{Current assets}}{\text{Current liabilities}}$
4.2	Liquidity Ratio	$\text{Quick ratio} = \dfrac{\text{Current assets} - \text{Inventory}}{\text{Current liabilities}}$
4.3	Efficiency Ratio	$\text{Inventory turnover} = \dfrac{\text{Cost of goods sold}}{\text{Inventory}}$
4.4	Efficiency Ratio	$\text{Day's sales in inventory} = \dfrac{365 \text{ days}}{\text{Inventory turnover}}$

continued

Equation	Description	Formula
4.5	Efficiency Ratio	$\text{Accounts receivable turnover} = \frac{\text{Net sales}}{\text{Accounts receivable}}$
4.6	Efficiency Ratio	$\text{Day's sales outstanding} = \frac{\text{365 days}}{\text{Accounts receivable turnover}}$
4.7	Efficiency Ratio	$\text{Total asset turnover} = \frac{\text{Net sales}}{\text{Total assets}}$
4.8	Efficiency Ratio	$\text{Fixed asset turnover} = \frac{\text{Net sales}}{\text{Net fixed assets}}$
4.9	Leverage Ratio	$\text{Total debt ratio} = \frac{\text{Total debt}}{\text{Total assets}}$
4.10	Leverage Ratio	$\text{Debt-to-equity ratio} = \frac{\text{Total debt}}{\text{Total equity}}$
4.11	Leverage Ratio	$\text{Equity multiplier} = \frac{\text{Total assets}}{\text{Total equity}}$
4.12	Leverage Ratio	$\text{Times interest earned} = \frac{\text{EBIT}}{\text{Interest expense}}$
4.13	Leverage Ratio	$\text{Cash coverage} = \frac{\text{EBITDA}}{\text{Interest expense}}$
4.14	Profitability Ratio	$\text{Gross profit margin} = \frac{\text{Net sales} - \text{Cost of goods sold}}{\text{Net sales}}$
4.15	Profitability Ratio	$\text{Operating profit margin} = \frac{\text{EBIT}}{\text{Net sales}}$
4.16	Profitability Ratio	$\text{Net profit margin} = \frac{\text{Net income}}{\text{Net sales}}$
4.17	Profitability Ratio	$\text{EBIT return on assets (EROA)} = \frac{\text{EBIT}}{\text{Total assets}}$
4.18	Profitability Ratio	$\text{Return on assets (ROA)} = \frac{\text{Net income}}{\text{Total assets}}$
4.19	Profitability Ratio	$\text{Return on equity (ROE)} = \frac{\text{Net income}}{\text{Total equity}}$
4.20	Market-Value-Indicator	$\text{Earning per share} = \frac{\text{Net income}}{\text{Shares outstanding}}$
4.21	Market-Value Indicator	$\text{Price-earnings ratio} = \frac{\text{Price per share}}{\text{Earnings per share}}$
4.22	Market-Value Indicator	$\text{Market-to-book ratio} = \frac{\text{Market value of equity per share}}{\text{Book value of equity per share}}$
4.23	ROA Breakdown	$\text{ROA} = \text{Net profit margin} \times \text{Total asset turnover}$
4.24	ROE Breakdown	$\text{ROE} = \text{ROA} \times \text{Equity multiplier}$
4.25	DuPont Equation	$\text{ROE} = \text{Net profit margin} \times \text{Total asset turnover} \times \text{Equity multiplier}$
4.26	DuPont Equation	$\text{ROE} = \frac{\text{Net income}}{\text{Net sales}} \times \frac{\text{Net sales}}{\text{Total assets}} \times \frac{\text{Total assets}}{\text{Total equity}}$

Self-Study Problems

4.1 The Abercrombie Supply Company reported the following information for 2017. Prepare a common-size income statement for the year ended June 30, 2017.

Abercrombie Supply Company Income Statement for the Fiscal Year Ended June 30, 2017 ($ thousands)	
Net sales	$2,110,965
Cost of goods sold	1,459,455
Selling and administrative expenses	312,044
Nonrecurring expenses	27,215
Earnings before interest, taxes, depreciation, and amortization (EBITDA)	$ 312,251
Depreciation	112,178
Earnings before interest and taxes (EBIT)	$ 200,073
Interest expense	117,587
Earnings before taxes (EBT)	$ 82,486
Taxes (35%)	28,870
Net income	$ 53,616

4.2 Prepare a common-size balance sheet from the following information for Abercrombie Supply Company.

Abercrombie Supply Company Balance Sheet as of June 30, 2017 ($ thousands)			
Assets:		Liabilities and Equity:	
Cash and marketable securities	$ 396,494	Accounts payable	$ 817,845
Accounts receivable	708,275	Notes payable	101,229
Inventory	1,152,398	Accrued income taxes	41,322
Other current assets	42,115	Total current liabilities	$ 960,396
Total current assets	$2,299,282	Long-term debt	1,149,520
Net plant and equipment	1,978,455	Total liabilities	$2,109,916
		Common stock	1,312,137
		Retained earnings	855,684
		Total common equity	$2,167,821
Total assets	$4,277,737	Total liabilities and equity	$4,277,737

4.3 Using the 2017 data for the Abercrombie Supply Company, calculate the following liquidity ratios:

- **a.** Current ratio.
- **b.** Quick ratio.

4.4 Refer to the balance sheet and income statement for Abercrombie Supply Company for the year ended June 30, 2017. Calculate the following ratios:

- **a.** Inventory turnover.
- **b.** Days' sales outstanding.
- **c.** Total asset turnover.
- **d.** Fixed asset turnover.
- **e.** Total debt ratio.
- **f.** Debt-to-equity ratio.
- **g.** Times-interest-earned.
- **h.** Cash coverage.

4.5 Last year ABC companies had accounts receivable turnover of 15, total asset turnover of 4.5, and total assets of $1,000,000. What was the value of ABC's accounts receivable? What was the value of its net sales?

4.6 The equity multiplier for Spiffy Corporation is 1.75, its EBIT return on assets (EROA) is 0.07, and the value of its equity is $850,000. What is the value of Spiffy's total assets? What is the value of its EBIT?

4.7 Refer again to the balance sheet and income statement for Abercrombie Supply Company for the fiscal year ended June 30, 2017. Use the DuPont equation to calculate the return on equity (ROE). In the process, calculate the following ratios: profit margin, EBIT return on assets, return on assets, equity multiplier, and total asset turnover.

Solutions to Self-Study Problems

4.1 The common-size income statement for Abercrombie Supply Company should look like the following one:

Abercrombie Supply Company Common-Size Income Statement for the Fiscal Year Ended June 30, 2017 ($ thousands)		
		% of Net Sales
Net sales	$2,110,965	100.0
Cost of goods sold	1,459,455	69.1
Selling and administrative expenses	312,044	14.8
Nonrecurring expenses	27,215	1.3
Earnings before interest, taxes, depreciation, and amortization (EBITDA)	$ 312,251	14.8
Depreciation	112,178	5.3
Earnings before interest and taxes (EBIT)	$ 200,073	9.5
Interest expense	117,587	5.6
Earnings before taxes (EBT)	$ 82,486	3.9
Taxes (35%)	28,870	1.4
Net income	$ 53,616	2.5

4.2 Abercrombie Supply's common-size balance sheet is as follows:

Abercrombie Supply Company Common-Size Balance Sheet as of June 30, 2017 ($ thousands)					
Assets:		% of Assets	Liabilities and Equity:		% of Assets
Cash and marketable securities	$ 396,494	9.3	Accounts payable and accruals	$ 817,845	19.1
Accounts receivable	708,275	16.5	Notes payable	101,229	2.4
Inventory	1,152,398	26.9	Accrued income taxes	41,322	1.0
Other current assets	42,115	1.0	Total current liabilities	$ 960,396	22.5
Total current assets	$2,299,282	53.7	Long-term debt	1,149,520	26.9
Net plant and equipment	1,978,455	46.3	Total liabilities	$2,109,916	49.3
			Common stock	1,312,137	30.7
			Retained earnings	855,684	20.0
			Total common equity	$2,167,821	50.7
Total asssets	$4,277,737	100.0	Total liabilities and equity	$4,277,737	100.0

4.3 Abercrombie Supply's current ratio and quick ratio are calculated as follows:

a. $$\text{Current ratio} = \frac{\$2,299,282}{\$960,396} = 2.39$$

b. $$\text{Quick ratio} = \frac{\$2,299,282 - \$1,152,398}{\$960,396} = 1.19$$

4.4 The ratios are calculated as shown in the following table:

Ratio	Calculation	Value
Inventory turnover	$1,459,455 / 1,152,398	1.27
Days' sales outstanding	$708,275 / ($2,110,965/365)	122.5 days
Total asset turnover	$2,110,965 / $4,277,737	0.49
Fixed asset turnover	$2,110,965 / $1,978,455	1.07
Total debt ratio	$2,109,916 / $4,277,737	0.493
Debt-to-equity ratio	$2,109,916 / $2,167,821	0.974
Times-interest-earned	$200,073 / $117,587	1.7
Cash coverage	$312,251 / $117,587	2.66

4.5 In this problem we can use the accounts receivable turnover equation (Equation 4.5) and total asset turnover equation (Equation 4.7) to solve for the values of accounts receivable and net sales.

$$\text{Accounts receivable turnover} = \frac{\text{Net sales}}{\text{Accounts receivable}}$$

$$\text{Total asset turnover} = \frac{\text{Net sales}}{\text{Total assets}}$$

Dividing accounts receivable turnover by total asset turnover yields:

$$\frac{\text{Net sales}}{\text{Accounts receivable}} / \frac{\text{Net sales}}{\text{Total assets}} = \frac{\text{Total assets}}{\text{Accounts receivable}}$$

$$= \frac{15}{4.5}$$

$$= 3.333$$

With total assets of $1,000,000, accounts must receivable equal:

$$\text{Accounts receivable} = \frac{\text{Total assets}}{3.3333}$$

$$= \frac{\$1,000,00}{3.3333}$$

$$= \$300,000$$

From the total asset turnover equation, net sales equal:

$$\text{Total asset turnover} = \frac{\text{Net sales}}{\text{Total assets}}$$

$$4.5 = \frac{\text{Net sales}}{\$1,000,000}$$

$$\text{Net sales} = (4.5)(\$1,000,000) = \$4,500,000$$

4.6 In this problem we can use the equity multiplier equation (Equation 4.11) and the EROA equation (Equation 4.17) to solve for the values of total assets and EBIT.

$$\text{Equity multiplier} = \frac{\text{Total assets}}{\text{Total equity}}$$

$$\text{EROA} = \frac{\text{EBIT}}{\text{Total assets}}$$

First, use the equity multiplier equation to solve for total assets:

$$\text{Equity multiplier} = \frac{\text{Total assets}}{\text{Total equity}}$$

$$1.75 = \frac{\text{Total assets}}{\$850,000}$$

$$\text{Total assets} = 1.75 \times \$850,000$$

$$= \$1,487,500$$

Next, use the EROA equation to solve for EBIT:

$$\text{EROA} = \frac{\text{EBIT}}{\text{Total assets}}$$

$$0.07 = \frac{\text{EBIT}}{\$1,487,500}$$

$$\text{EBIT} = 0.07 \times \$1,487,500$$

$$= \$104,125$$

4.7 Following are the calculations for the ROE and associated ratios:

$$\text{Net profit margin} = \frac{\text{Net income}}{\text{Net sales}} = \frac{\$53{,}616}{\$2{,}110{,}965} = 0.0254, \text{ or } 2.54\%$$

$$\text{EBIT ROA} = \frac{\text{EBIT}}{\text{Total assets}} = \frac{\$200{,}073}{\$4{,}277{,}737} = 0.0468, \text{ or } 4.68\%$$

$$\text{Return on assets} = \frac{\text{Net income}}{\text{Total assets}} = \frac{\$53{,}616}{\$4{,}277{,}737} = 0.0125, \text{ or } 1.25\%$$

$$\text{Equity multiplier} = \frac{\text{Total assets}}{\text{Total equity}} = \frac{\$4{,}277{,}737}{\$2{,}167{,}821} = 1.97$$

$$\text{Total asset turnover} = \frac{\text{Net sales}}{\text{Total assets}} = \frac{\$2{,}110{,}965}{\$4{,}277{,}737} = 0.49$$

DuPont identity:

$$\begin{aligned}\text{ROE} &= \text{ROA} \times \text{Equity multiplier}\\ &= \text{Net profit margin} \times \text{Total asset turnover ratio} \times \text{Equity multiplier}\\ &= \frac{\text{Net income}}{\text{Net sales}} \times \frac{\text{Net sales}}{\text{Total assets}} \times \frac{\text{Total assets}}{\text{Total equity}}\\ &= 0.0254 \times 0.49 \times 1.97\\ &= 0.0245, \text{ or } 2.45\%\end{aligned}$$

Discussion Questions

4.1 What does it mean when a company's return on assets (ROA) is equal to its return on equity (ROE)?

4.2 Why is too much liquidity not a good thing?

4.3 Inventory is excluded when the quick ratio or acid-test ratio is calculated because inventory is the most difficult current asset to convert to cash without loss of value. What types of inventory are likely to be most easily converted to cash without loss of value?

4.4 What does a very high inventory turnover ratio signify?

4.5 How would one explain a low receivables turnover ratio?

4.6 What additional information does the fixed asset turnover ratio provide over the total asset turnover ratio? For which industries does it carry greater significance?

4.7 How does financial leverage help stockholders?

4.8 Why is ROE generally much higher than ROA for banks relative to other industries?

4.9 Why is the ROE a more appropriate proxy for stockholder value maximization for some firms than for other firms?

4.10 Why is it not enough for an analyst to look at just the short-term and long-term debt on a firm's balance sheet when assessing the firm's fixed obligations?

Questions and Problems

Basic

4.1 **Liquidity ratios:** Explain why the quick ratio or acid-test ratio is a better measure of a firm's liquidity than the current ratio.

4.2 **Liquidity ratios:** Flying Penguins Corp. has total current assets of $11,845,175, current liabilities of $5,311,020, and a quick ratio of 0.89. How much inventory does it have?

4.3 Efficiency ratio: If Newton Manufacturers has an accounts receivable turnover of 4.8 times and net sales of $7,812,379, what would its receivables be?

4.4 Efficiency ratio: Bummel and Strand Corp. has a gross profit margin of 33.7 percent, sales of $47,112,365, and inventory of $14,595,435. What is its inventory turnover ratio?

4.5 Efficiency ratio: Sorenson Inc. has sales of $3,112,489, a gross profi t margin of 23.1 percent, and inventory of $833,145. What are the company's inventory turnover ratio and days' sales in inventory?

4.6 Leverage ratios: Breckenridge Ski Company has total assets of $422,235,811 and a debt ratio of 29.5 percent. Calculate the company's debt-to-equity ratio and equity multiplier.

4.7 Leverage ratios: Norton Company has a debt-to-equity ratio of 1.65, ROA of 11.3 percent, and total equity of $1,322,796. What are the company's equity multiplier, debt ratio, and ROE?

4.8 DuPont equation: The Rangoon Timber Company has the following ratios:

Net sales/Total assets = 2.23 ROA = 9.69% ROE = 16.4%

What are Rangoon's profit margin and debt ratios?

4.9 DuPont equation: Lemmon Enterprises has a total asset turnover of 2.1 and a net profi t margin of 7.5%. If its equity multiplier is 1.90, what is the ROE for Lemmon Enterprises?

4.10 Benchmark analysis: List the ways a company's financial manager can benchmark the company's own performance.

4.11 Benchmark analysis: Trademark Corp.'s financial manager collected the following information to compare its performance against that of its peers.

Ratios	Trademark	Peer Group
DSO	33.5 days	27.9 days
Total asset turnover	2.3	3.7
Inventory turnover	1.8	2.8
Quick ratio	0.6	1.3

a. Explain how Trademark is performing relative to its peers.

b. How do the industry ratios help Trademark's management?

4.12 Market-value ratios: Rockwell Jewelers management announced that the company had net earnings of $6,481,778 for this year. The company has 2,543,800 shares outstanding, and the year-end stock price is $54.21. What are Rockwell's earnings per share and P/E ratio?

4.13 Market-value ratios: Chisel Corporation has 3 million shares outstanding at a price per share of $3.25. If the debt-to-equity ratio is 1.7 and total book value of debt equals $12,400,000, what is the market-to-book ratio for Chisel Corporation?

Intermediate

4.14 Liquidity ratios: Laurel Electronics has a quick ratio of 1.15, current liabilities of $5,311,020, and inventories of $7,121,599. What is the firm's current ratio?

4.15 Efficiency ratio: Lambda Corporation has current liabilities of $450,000, a quick ratio of 1.8, inventory turnover of 5.0, and a current ratio of 3.5. What is the cost of goods sold for Lambda Corporation?

4.16 Efficiency ratio: Norwood Corp. currently has accounts receivable of $1,223,675 on net sales of $6,216,900. What are its accounts receivable turnover and days' sales outstanding (DSO)?

4.17 Efficiency ratio: If Norwood Corp.'s management wants to reduce the DSO from that calculated in Problem 4.16 to an industry average of 56.3 days and its net sales are expected to decline by about 12 percent, what would the new level of receivables be?

4.18 Coverage ratios: Nimitz Rental Company had depreciation expenses of $108,905, interest expenses of $78,112, and an EBIT of $1,254,338 for the year ended June 30, 2017. What are the times-interest-earned and cash coverage ratios for this company?

4.19 Leverage ratios: Conseco, Inc., has a debt ratio of 0.56. What are the company's debt-to-equity ratio and equity multiplier?

4.20 Profitability ratios: Cisco Systems has total assets of $35.594 billion, total debt of $9.678 billion, and net sales of $22.045 billion. Its net profit margin for the year is 20 percent, while the operating profit margin is 30 percent. What are Cisco's net income, EROA, ROA, and ROE?

4.21 Profitability ratios: Procter & Gamble reported the following information for its fiscal year end: On net sales of $51.407 billion, the company earned net income after taxes of $6.481 billion. It had cost of goods sold of $25.076 billion and EBIT of $9.827 billion. What are the company's gross profit margin, operating profit margin, and net profit margin?

4.22 Profitability ratios: Wal-Mart, Inc., has net income of $9,054,000 on net sales of $256,329,812. The company has total assets of $104,912,112 and stockholders' equity of $43,623,445. Use the extended DuPont identity to find the return on assets and return on equity for the firm.

4.23 Profitability ratios: Xtreme Sports Innovations has disclosed the following information:

EBIT = $25,664,300 Net income = $13,054,000

Net sales = $83,125,336 Total debt = $20,885,753

Total assets = $71,244,863

Compute the following ratios for this firm using the DuPont identity: debt-to-equity ratio, EROA, ROA, and ROE.

4.24 Market-value ratios: Cisco Systems had net income of $4.401 billion and, at year end, 6.735 billion shares outstanding. Calculate the earnings per share for the company.

4.25 Market-value ratios: Use the information for Cisco Systems in Problem 4.24. In addition, the company's EBITDA was $6.834 billion and its share price was $22.36. Compute the firm's price-earnings ratio.

4.26 DuPont equation: Carter, Inc., a manufacturer of electrical supplies, has an ROE of 23.1 percent, a profit margin of 4.9 percent, and a total asset turnover ratio of 2.6 times. Its peer group also has an ROE of 23.1 percent, but has outperformed Carter with a net profit margin of 5.3 percent and a total asset turnover ratio of 3.0 times. Explain how Carter managed to achieve the same level of profitability as reflected by the ROE.

4.27 DuPont equation: Grossman Enterprises has an equity multiplier of 2.6 times, total assets of $2,312,000, an ROE of 14.8 percent, and a total asset turnover ratio of 2.8 times. Calculate the firm's sales and ROA.

Advanced

4.28 Complete the balance sheet of Flying Roos Corporation.

Flying Roos Corporation Balance Sheet as of December 31, 2017			
Assets:		Liabilities and Equity:	
Cash and marketable securities		Accounts payable and accruals	
Accounts receivable		Notes payable	$ 300,000
Inventory		Total current liabilities	
Total current assets			
		Long-term debt	$2,000,000
Net plant and equipment		Common stock	
		Retained earnings	$1,250,000
Total assets	$8,000,000	Total liabilities and equity	

You have the following information:

Debt ratio = 40%	DSO = 39 days
Current ratio = 1.5	Inventory turnover ratio = 3.375
Net sales = $2.25 million	Cost of goods sold = $1.6875 million

4.29 For the year ended June 30, 2017, Northern Clothing Company has total assets of $87,631,181, ROA of 11.67 percent, ROE of 21.19 percent, and a net profit margin of 11.59 percent. What are the company's net income and net sales? Calculate the firm's debt-to-equity ratio.

4.30 Blackwell Automotive's balance sheet at the end of its most recent fiscal year shows the following information:

Blackwell Automotive Balance Sheet as of March 31, 2017			
Assets:		Liabilities and Equity:	
Cash and marketable securities	$ 23,015	Accounts payable and accruals	$ 163,257
Accounts receivable	141,258	Notes payable	21,115
Inventory	212,444	Total current liabilities	$ 184,372
Total current assets	$ 376,717	Long-term debt	168,022
Net plant and equipment	711,256	Total liabilities	$ 352,394
Goodwill and other assets	89,879	Common stock	313,299
		Retained earnings	512,159
Total assets	$1,177,852	Total liabilities and equity	$1,177,852

In addition, it was reported that the firm had a net income of $156,042 on net sales of $4,063,589.

a. What are the firm's current ratio and quick ratio?

b. Calculate the firm's days' sales outstanding, total asset turnover ratio, and fixed asset turnover ratio.

4.31 The following are the financial statements for Nederland Consumer Products Company for the fiscal year ended September 30, 2017.

Nederland Consumer Products Company Income Statement for the Fiscal Year Ended September 30, 2017	
Net sales	$51,407
Cost of products sold	25,076
Gross profit	$26,331
Marketing, research, administrative expense	15,746
Depreciation	758
Operating income (loss)	$ 9,827
Interest expense	477
Earnings (loss) before income taxes	$ 9,350
Income taxes	2,869
Net earnings (loss)	$ 6,481

Nederland Consumer Products Company Balance Sheet as of September 30, 2017			
Assets:		Liabilities and Equity:	
Cash and marketable securities	$ 5,469	Accounts payable	$ 3,617
Investment securities	423	Accrued and other liabilities	7,689
Accounts receivable	4,062	Taxes payable	2,554
Inventory	4,400	Debt due within one year	8,287
Deferred income taxes	958	Total current liabilities	$22,147
Prepaid expenses and other receivables	1,803	Long-term debt	12,554
		Deferred income taxes	2,261
Total current assets	$17,115	Other noncurrent liabilities	2,808
Property, plant, and equipment, at cost	25,304	Total liabilities	$39,770
		Convertible class A preferred stock	1,526
Less: Accumulated depreciation	11,196		
Net property, plant, and equipment	$14,108	Common stock	2,141
Net goodwill and other intangible assets	23,900	Retained earnings	13,611
		Total stockholders' equity	$17,278
Other noncurrent assets	1,925		
Total assets	$57,048	Total liabilities and equity	$57,048

Calculate all the ratios, for which industry figures are available below, for Nederland and compare the firm's ratios with the industry ratios.

Ratio	Industry Average
Current ratio	2.05
Quick ratio	0.78
Gross margin	23.9%
Net profit margin	12.3%
Debt ratio	0.23
Long-term debt to equity	0.98
Interest coverage	5.62
ROA	5.3%
ROE	18.8%

4.32 Refer to the preceding information for Nederland Consumer Products Company. Compute the firm's ratios for the following categories and briefly evaluate the company's performance using these numbers.

a. Efficiency ratios.
b. Asset turnover ratios.
c. Leverage ratios.
d. Coverage ratios.

4.33 Refer to the earlier information for Nederland Consumer Products Company. Using the DuPont identity, calculate the return on equity for Nederland, after calculating the ratios that make up the DuPont identity.

4.34 Nugent, Inc., has a gross profit margin of 31.7 percent on net sales of $9,865,214 and total assets of $7,125,852. The company has a current ratio of 2.7 times, accounts receivable of $1,715,363, cash and marketable securities of $315,488, and current liabilities of $870,938.

a. What is Nugent's total current assets?
b. How much inventory does the firm have? What is the inventory turnover ratio?
c. What is Nugent's days' sales outstanding?
d. If management sets a target DSO of 30 days, what should Nugent's accounts receivable be?

4.35 Recreational Supplies Co. has net sales of $11,655,000, an ROE of 17.64 percent, and a total asset turnover of 2.89 times. If the firm has a debt-to-equity ratio of 1.43, what is the company's net income?

4.36 Nutmeg Houseware Inc. has an operating profit margin of 10.3 percent on revenues of $24,547,125 and total assets of $8,652,352.

a. Calculate the company's total asset turnover ratio and its operating profit (EBIT).
b. The company's management has set a target for the total asset turnover ratio of 3.25 for next year. If there is no change in the total assets of the company, what will the new net sales level have to be next year? Calculate the dollar change in sales necessary and the percentage change in sales necessary.
c. If the operating profit margin declines to 10 percent, what will be the EBIT at the new level of net sales?

4.37 Modern Appliances Corporation has reported its financial results for the year ended December 31, 2017.

Modern Appliances Corporation Income Statement for the Fiscal Year Ended December 31, 2017	
Net sales	$5,398,412,000
Cost of goods sold	3,432,925,255
Gross profit	$1,965,486,745
Selling, general, and administrative expenses	1,036,311,231
Depreciation	299,928,155
Operating income	$ 629,247,359
Interest expense	35,826,000
EBT	$ 593,421,359
Income taxes	163,104,554
Net earnings	$ 430,316,805

Modern Appliances Corporation Balance Sheet as of December 31, 2017			
Assets:		Liabilities and Equity:	
Cash and cash equivalents	$ 514,412,159	Short-term borrowings	$ 117,109,865
Accounts receivable	1,046,612,233	Trade accounts payable	466,937,985
Inventory	981,870,990	Other current liabilities	994,289,383
Other current assets	313,621,610	Total current liabilities	$1,578,337,233
Total current assets	$ 2,856,516,992	Long-term debt	1,200,691,565
Net fixed assets	754,660,275	Common stock	397,407,352
Goodwill	118,407,710	Retained earnings	1,218,207,588
Other assets	665,058,761		
Total assets	$4,394,643,738	Total liabilities and equity	$4,394,643,738

Using the information from the financial statements, complete a comprehensive ratio analysis for Modern Appliances Corporation.

a. Calculate these liquidity ratios: current and quick ratios.
b. Calculate these efficiency ratios: inventory turnover, accounts receivable turnover, DSO.
c. Calculate these asset turnover ratios: total asset turnover, fixed asset turnover.
d. Calculate these leverage ratios: total debt ratio, debt-to-equity ratio, equity multiplier.
e. Calculate these coverage ratios: times interest earned, cash coverage.
f. Calculate these profitability ratios: gross profit margin, net profit margin, ROA, ROE.
g. Use the DuPont identity, after calculating the component ratios, to compute ROE.

CFA Problems

4.38 Common-size analysis is used in financial analysis to:

a. evaluate changes in a company's operating cycle over time.
b. predict changes in a company's capital structure using regression analysis.
c. compare companies of different sizes or compare a company with itself over time.
d. restate each element in a company's financial statement as a proportion of the similar account for another company in the same industry.

4.39 The TBI Company has a number of days of inventory of 50. Therefore, the TBI Company's inventory turnover is closest to:

a. 4.8 times. **c.** 8.4 times.
b. 7.3 times. **d.** 9.6 times.

4.40 DuPont analysis involves breaking return-on-assets ratios into their:

a. profit components.
b. marginal and average components.
c. operating and financing components.
d. profit margin and turnover components.

4.41 If a company's net profit margin is −5 percent, its total asset turnover is 1.5 times, and its financial leverage ratio is 1.2 times, its return on equity is closest to:

a. −9.0 percent. **c.** −3.2 percent.
b. −7.5 percent. **d.** 1.8 percent.

Sample Test Problems

Greenfern Corporation recently filed the following financial statements with the SEC.

Greenfern Corporation Income Statement for the Fiscal Year Ended July 31, 2017	
Net sales	$ 73,236
Cost of products sold	52,092
Gross profit	$ 21,144
Selling, general, and administrative expenses	9,333
Depreciation	1,060
Operating income (loss)	$ 10,751
Interest expense	649
Earning (loss) before income taxes	10,102
Income taxes	3,536
Net earnings (loss)	$ 6,566

Greenfern Corporation Balance Sheet as of July 31, 2017			
Assets:		**Liabilities and Equity:**	
Cash and marketable securities	$ 9,118	Accounts payable	$ 6,379
Accounts receivable	7,844	Accrued and other liabilities	5,663
Inventory	8,900	Taxes payable	4,821
Deferred income taxes	878	Debt due within one year	10,778
Prepaid expenses and other	2,803	Total current liabilities	$27,641
Total current assets	$29,543		
Property, plant, and equipment, at cost	62,467	Long-term debt	24,280
		Deferred income taxes	6,903
Less: Accumulated depreciation	22,196	Other non current liabilities	5,608
Net property, plant, and equipment	$40,271	Total liabilities	$64,432
		Common stock	3,667
Net goodwill and other intangible assets	16,270	Retained earnings	17,985
		Total stockholders' equity	$21,652
		Total liabilities and stockholders'	
Total assets	$86,084	equity	$86,084

4.1 Refer to the preceding balance sheet and income statement for Greenfern Corporation for the fiscal year ended July 31, 2017. What are the company's current ratio and quick ratio? What do these ratios tell us about Greenfern?

4.2 Refer to the preceding balance sheet and income statement for Greenfern Corporation for the fiscal year ended July 31, 2017. Calculate the following ratios:

a. Inventory turnover
b. Days' sales outstanding.
c. Total asset turnover.
d. Fixed asset turnover.
e. Total debt ratio.
f. Debt-to-equity ratio.
g. Times interest earned ratio.
h. Cash coverage ratio.

4.3 Refer to the preceding balance sheet and income statement for Greenfern Corporation for the fiscal year ended July 31, 2017. Use the DuPont identity to calculate the return on equity (ROE). In the process, calculate the following ratios: net profit margin, total asset turnover, equity multiplier, EBIT return on assets (EROA), and return on assets.

4.4 Last year Pontiff Enterprises reported net sales of $13,144,680, a gross profit $4,127,429, EBIT of $2,586,150, and net income of $867,555. Compute Pontiff's cost of goods sold, gross profit margin, operating profit margin, and net profit margin.

4.5 National City Bank has 646,749,650 shares of common stock outstanding that are currently selling for $37.55 per share on the New York Stock Exchange. If National City's net income was $2,780,955,000 in the year that just ended, what was its earnings per share and what is its current price-earnings ratio? If the typical price-earnings ratio for a bank is currently 15, what does the price-earnings ratio for National City tell you about its prospects?

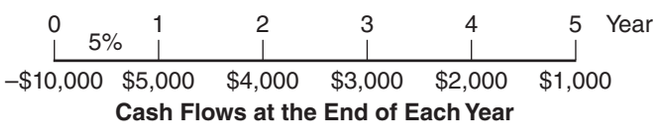


EXHIBIT 5.1 **Five-Year Time Line for a $10,000 Investment**

Time lines help us to correctly identify the size and timing of cash flows—critical tasks in solving time value problems. This time line shows the cash flows generated over five years by a $10,000 investment where the relevant interest rate is 5 percent.

Figure 5.1

$$FV_1 = P_0 + (P_0 \times i)$$
$$= P_0 \times (1 + i)$$

Figure 5.2

$$FV_1 = \$100 \times (1 + 0.10)$$
$$= \$100 \times 1.10$$
$$= \$110$$

Figure 5.3

$$FV_2 = FV_1 \times (1 + i)$$
$$= [P_0 \times (1 + i)] \times (1 + i)$$
$$= P_0 \times (1 + i)^2$$

Figure 5.4

$$FV_2 = P_0 \times (1 + i)^2$$
$$= \$100 \times (1 + 0.10)^2$$
$$= \$100 \times (1.10)^2$$
$$= \$100 \times 1.21$$
$$= \$121$$

EXHIBIT 5.2 **Future Value of $100 at 10 Percent**

With compounding, interest earned on an investment is reinvested so that, in future periods, interest is earned on interest as well as on the principal amount. Here, interest on interest begins accruing in Year 2.

Year (1)	Value at Beginning of Year (2)	Interest Earned					Value at End of Year (6)
		Simple Interest (3)		Interest on Interest (4)		Total (Compound) Interest (5)	
1	$100.00	$10.00	+	$ 0.00	=	$10.00	$110.00
2	110.00	10.00	+	1.00	=	11.00	121.00
3	121.00	10.00	+	2.10	=	12.10	133.10
4	133.10	10.00	+	3.31	=	13.31	146.41
5	146.41	10.00	+	4.64	=	14.64	161.05
Five-year total	$100.00	$50.00	+	$11.05	=	$61.05	$161.05

Figure 5.5

$$FV_3 = P_0 \times (1 + i)^3$$

Figure 5.6

$$FV_n = P_0 \times (1 + i)^n$$

$$FV_n = PV \times (1 + i)^n \qquad (5.1)$$

Figure 5.7

$$FV_1 = P_0 + (P_0 \times i)$$
$$FV_1 - P_0 = P_0 \times i$$
$$SI = P_0 \times i$$

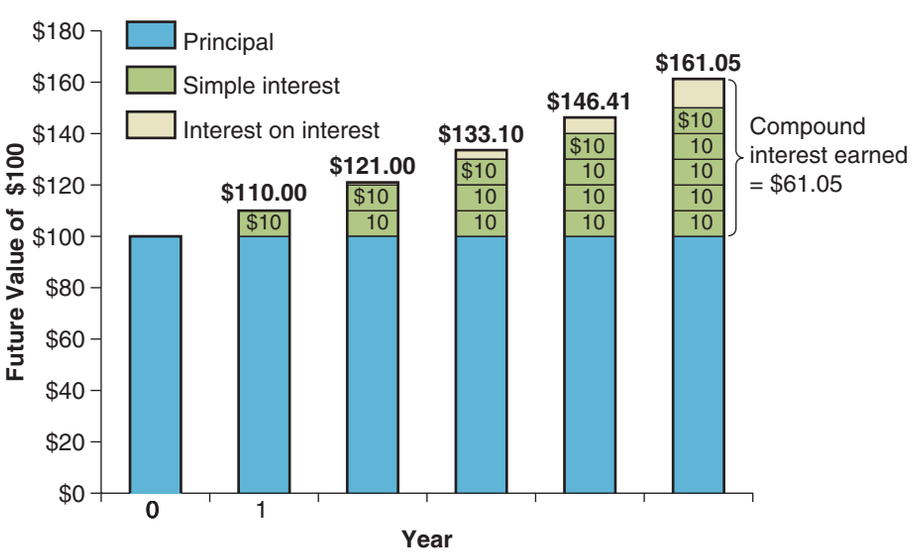


EXHIBIT 5.3 **How Compound Interest Grows on $100 at 10 Percent**

The amount of simple interest earned on $100 invested at 10 percent remains constant at $10 per year, but the amount of interest earned on interest increases each year. As more and more interest builds, the effect of compounding accelerates the growth of the total interest earned.

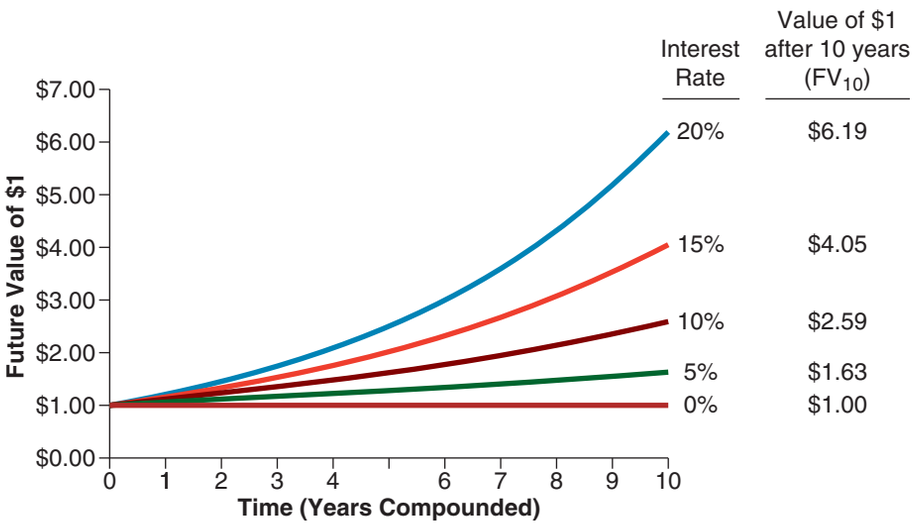


EXHIBIT 5.4 **Future Value of $1 for Different Periods and Interest Rates**

The higher the interest rate, the faster the value of an investment will grow, and the larger the amount of money that will accumulate over time. Because of compounding, the growth over time is not linear but exponential—the dollar increase in the future value is greater in each subsequent period.

Figure 5.8

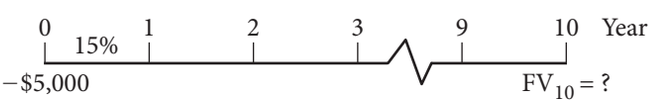


Figure 5.9

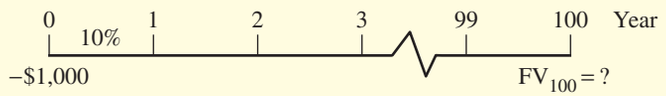
$$FV_n = PV \times (1 + i)^n$$
$$FV_{10} = \$5{,}000 \times (1 + 0.15)^{10}$$
$$= \$5{,}000 \times 4.045558$$
$$= \$20{,}227.79$$

APPLICATION 5.1 | The Power of Compounding

LEARNING BY DOING

Problem Your wealthy uncle passed away, and one of the assets he left to you was a savings account that your great-grandfather had set up 100 years ago. The account had a single deposit of $1,000 and paid 10 percent interest per year. How much money have you inherited, what is the total compound interest, and how much of the interest earned came from interest on interest?

Approach We first determine the value of the inheritance, which is the future value of $1,000 retained in a savings account for 100 years at a 10 percent interest rate. Our time line for the problem is:



To calculate FV_{100}, we begin by computing the future value factor. We then plug this number into the future value formula (Equation 5.1) and solve for the total inheritance. Once we have computed FV_{100}, we calculate the total compound interest and the total simple interest and find the difference between these two numbers, which will give us the interest earned on interest.

Solution First, we find the future value factor:

$$(1 + i)^n = (1 + 0.10)^{100} = (1.10)^{100} = 13{,}780.612$$

Then we find the future value:

$$\begin{aligned} FV_n &= PV \times (1 + i)^n \\ FV_{100} &= \$1{,}000 \times (1.10)^{100} \\ &= \$1{,}000 \times 13{,}780.612 \\ &= \$13{,}780{,}612 \end{aligned}$$

Your total inheritance is $13,780,612. The total compound interest earned is this amount less the original $1,000 investment, or $13,779,612:

$$\$13{,}780{,}612 - \$1{,}000 = \$13{,}779{,}612$$

The total simple interest earned is calculated as follows:

$$\begin{aligned} P_0 \times i &= \$1{,}000 \times 0.10 = \$100 \text{ per year} \\ \$100 \times 100 \text{ years} &= \$10{,}000 \end{aligned}$$

The interest earned on interest is the difference between the total compound interest earned and the simple interest:

$$\$13{,}779{,}612 - \$10{,}000 = \$13{,}769{,}612$$

That's quite a difference!

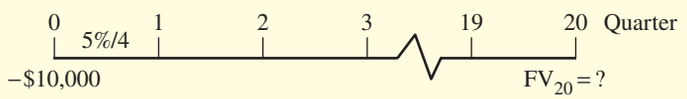
$$FV_n = PV \times (1 + i/m)^{m \times n} \qquad (5.2)$$

APPLICATION 5.2 | Changing the Compounding Period

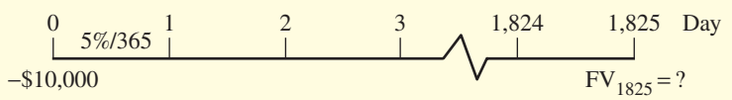
LEARNING BY DOING

Problem Your grandmother has $10,000 she wants to put into a bank savings account for five years. The bank she is considering is within walking distance, pays 5 percent annual interest compounded quarterly (5 percent per year/4 quarters per year = 1.25 percent per quarter), and provides free coffee and doughnuts in the morning. Another bank in town pays 5 percent interest compounded daily. Getting to this bank requires a bus trip, but your grandmother can ride free as a senior citizen. More important, though, this bank does not serve coffee and doughnuts. Which bank should your grandmother select?

Approach We need to calculate the difference between the two banks' interest payments. Bank A, which compounds quarterly, will pay one-fourth of the annual interest per quarter, 0.05/4 = 0.0125, and there will be 20 compounding periods over the five-year investment horizon (5 years × 4 quarters per year = 20 quarters). The time line for quarterly compounding is as follows:



Bank B, which compounds daily, has 365 compounding periods per year. Thus, the daily interest rate is 0.000137 (0.05/365 = 0.000137), and there are 1,825 (5 years × 365 days per year = 1,825 days) compounding periods. The time line for daily compounding is:



We use Equation 5.2 to solve for the future values the investment would generate at each bank. We then compare the two.

Solution

Bank A:

$$\begin{aligned} FV_n &= PV \times (1 + i/m)^{m \times n} \\ FV_{qtrly} &= \$10{,}000 \times (1 + 0.05/4)^{4 \times 5} \\ &= \$10{,}000 \times (1 + 0.0125)^{20} \\ &= \$12{,}820.37 \end{aligned}$$

Bank B:

$$\begin{aligned} FV_n &= PV \times (1 + i/m)^{m \times n} \\ FV_{daily} &= \$10{,}000 \times (1 + 0.05/365)^{365 \times 5} \\ &= \$10{,}000 \times (1 + 0.000137)^{1{,}825} \\ &= \$12{,}840.03 \end{aligned}$$

With daily compounding, the additional interest earned by your grandmother is $19.66:

$$\$12{,}840.03 - \$12{,}820.37 = \$19.66$$

Given that the interest gained by daily compounding is less than $20, your grandmother should probably select her local bank and enjoy the daily coffee and doughnuts. (If she is on a diet, of course, she should take the higher interest payment and walk to the other bank.)

It is worth noting that the longer the investment period, the greater the additional interest earned from daily compounding versus quarterly compounding. For example, if $10,000 was invested for 40 years instead of five years, the additional interest would increase to $899.91. You should confirm this by doing the calculation.

$$FV_{\infty} = PV \times e^{i \times n} \qquad (5.3)$$

EXAMPLE 5.1 | Which Bank Offers Depositors the Best Deal?

DECISION MAKING

Situation You have just received a bonus of $10,000 and are looking to deposit the money in a bank account for five years. You investigate the annual deposit rates of several banks and collect the following information:

Bank	Compounding Frequency	Annual Rate
A	Annually	5.00%
B	Quarterly	5.00%
C	Monthly	4.80%
D	Daily	4.85%

You understand that the more frequently interest is compounded in each year, the more you will have at the end of your five-year investment horizon. To determine in which bank you should deposit your money, you calculate how much money you will have at the end of five years at each bank. You apply Equation 5.2 and obtain the following results. Which bank should you choose?

Bank	Investment Amount	Compounding Frequency	Rate	Value after 5 Years
A	$10,000	Annually	5.00%	$12,762.82
B	$10,000	Quarterly	5.00%	$12,820.37
C	$10,000	Monthly	4.80%	$12,706.41
D	$10,000	Daily	4.85%	$12,744.11

Decision Without making any calculations, we can exclude Bank A from consideration because we know that Bank B's CD will have a higher value at the end of five years. The reason is that the CDs from Banks A and B have the same investment amount ($10,000), maturity (five years), and annual interest rate (5 percent); they differ only in their compounding frequency. Bank B's quarterly compounding will result in a higher value than Bank A's annual compounding. Since the CDs from Banks B, C, and D differ in both their annual rates and compounding frequencies, there is no way to determine the most attractive among them without doing future value calculations. These calculations reveal that the CD from Bank B will provide the highest value at the end of five years. You should choose Bank B.

Figure 5.10

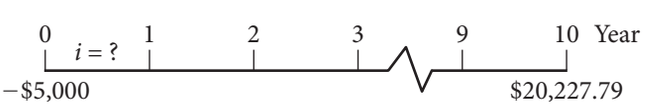


EXHIBIT 5.5 Tips for Using Financial Calculators

Following these tips will help you avoid problems that sometimes arise in solving time value of money problems with a financial calculator.

Use the Correct Compounding Period. Make sure that your calculator is set to compound one payment per period or per year. Because financial calculators are often used to compute monthly payments, some will default to monthly payments unless you indicate otherwise. You will need to consult your calculator's instruction manual because procedures for changing settings vary by manufacturer. Most of the problems you will work in other chapters of this book will compound annually.

Clear the Financial Register of the Calculator Before Starting. Be sure you clear the data from the financial register before starting to work a problem because most calculators retain information between calculations. Since the information may be retained even when the calculator is turned off, turning the calculator off and on will not solve this problem. Check your instruction manual for the correct procedure for clearing the financial register of your calculator.

Ensure the Signs on Cash Outflows and Inflows Are Consistent. For certain types of calculations, you must input a negative (positive)sign for all cash outflows and a positive (negative) sign for all cash inflows. Otherwise, the calculator cannot make the computation, and the answer screen will display an error message, or the answer will be incorrect.

Putting a Negative Sign on a Number. To create a number with a negative sign, enter the number first and then press the "change of sign key." These keys are typically labeled "CHS" or "+/−".

Entering an Interest Rate as a Percentage. Most financial calculators require that interest rate data be entered in percentage form, not in decimal form. For example, enter 7.125 percent as 7.125 and not 0.07125. Unlike nonfinancial calculators, financial calculators assume that rates are stated as percentages.

Rounding Off Numbers. Never round off any numbers until all your calculations are complete. If you round off numbers along the way, you can generate significant rounding errors.

Adjusting the Decimal Setting. Most calculators are set to display two decimal places. You will find it convenient at times to display four or more decimal places when making financial calculations, especially when working with interest rates or present value factors. Again, consult your instruction manual.

Having the mode correctly set to BEG or END. In finance, most problems that you solve will involve cash payments that occur at the end of each time period. Most calculators normally operate in this mode, which is usually designated as "END" mode. However, in some problems the cash payments occur at the beginning of each period. This setting is designated as the "BEG" mode. When your financial calculator was purchased, it was set in the END mode. Financial calculators allow you to switch between the END and BEG modes.

Using Excel

Time Value of Money

Spreadsheet programs are a popular method for setting up and solving finance and accounting problems. Throughout this book, we will show you how to structure and calculate some problems using the Microsoft Excel spreadsheet program. Spreadsheet programs are like your financial calculator but are especially efficient at doing repetitive calculations. For example, once the spreadsheet program is set up, it will allow you to make computations using preprogrammed formulas. Thus, you can simply change any of the input cells, and the preset formula will automatically recalculate the answer based on the new input values. For this reason, we recommend that you use formulas whenever possible.

We begin our spreadsheet applications with time value of money calculations. As with the financial calculator approach, there are five variables used in these calculations, and knowing any four of them will let you calculate the fifth one. Excel includes preset formulas for you to use. These are as follows:

Solving for	**Formula**
Present Value	= PV(RATE, NPER, PMT, FV)
Future Value	= FV(RATE, NPER, PMT, PV)
Discount Rate	= RATE(NPER, PMT, PV, FV)
Payment	= PMT(RATE, NPER, PV, FV)
Number of Periods	= NPER(RATE, PMT, PV, FV)

To enter a formula, all you have to do is type in the equal sign, the abbreviated name of the variable you want to compute, and an open parenthesis, and Excel will automatically prompt you to enter the rest of the variables. Here is an example of what you would type to compute the future value:

1. =
2. FV
3. (

Here are a few important things to note when entering the formulas: (1) be consistent with signs for cash inflows and outflows; (2) enter the rate of return as a decimal number, not a percentage; and (3) enter the amount of an unknown payment as zero.

To see how a problem is set up and how the calculations are made using a spreadsheet, let's return to Learning by Doing Application 5.2.

	A	B	C	D	E	F
1						
2		**Time Value of Money Calculations**				
3						
4	Your grandmother wants to put $10,000 into a bank savings account for five years. Bank A pays 5 percent					
5	interest compounded quarterly, while Bank B offers 5 percent compounded daily. Which bank should your					
6	grandmother choose?					
7						
8	To answer the question, we need to solve for the future value.					
9						
10	**Problem setup and solution:**					
11						
12		**Bank A**	**Bank B**		**Comment**	
13	Present value	($10,000)	($10,000)		Value given	
14	Interest rate	0.01250	0.00014		Interest rate/# compounding periods per year	
15	Number of periods	20	1825		# years × # compounding periods per year	
16	**Future value**	**$12,820.37**	**$12,840.03**		See note below	
17						
18						
19	The formula entered to calculate the future value for Bank A in cell B16 is =FV(B14, B15, 0, B13). Similarly, the					
20	formula to calculate the future value for Bank B in cell C16 is =FV(C14, C15, 0, C13). Since there are no					
21	payments, we enter PMT as zero. Also, notice that to be consistent with what we have said about cash inflows					
22	and outflows so far, the present value is entered as a negative number.					
23						

Figure 5.11

$$PV = \frac{FV_1}{1 + i}$$

Figure 5.12

$$\begin{aligned} PV &= \frac{FV_1}{1+i} \\ &= \frac{\$110}{1+0.10} \\ &= \frac{\$110}{1.10} \\ &= \$100 \end{aligned}$$

Figure 5.13

$$PV = \frac{FV_1}{1+i}$$

Figure 5.14

$$PV = FV_1 \times \frac{1}{1+i}$$

Figure 5.15

$$PV = \frac{FV_2}{(1+i)^2}$$

Figure 5.16

$$\begin{aligned} PV &= \frac{FV_2}{(1+i)^2} \\ &= \frac{\$121}{(1+0.10)^2} \\ &= \frac{\$121}{1.21} \\ &= \$100 \end{aligned}$$

Figure 5.17

$$PV = \frac{FV_3}{(1+i)^3}$$

$$PV = \frac{FV_n}{(1+i)^n} \tag{5.4}$$

Figure 5.18

$$PV = FV_n \times \frac{1}{(1+i)^n}$$

Figure 5.19

$$PV = FV_n \times DF_n$$

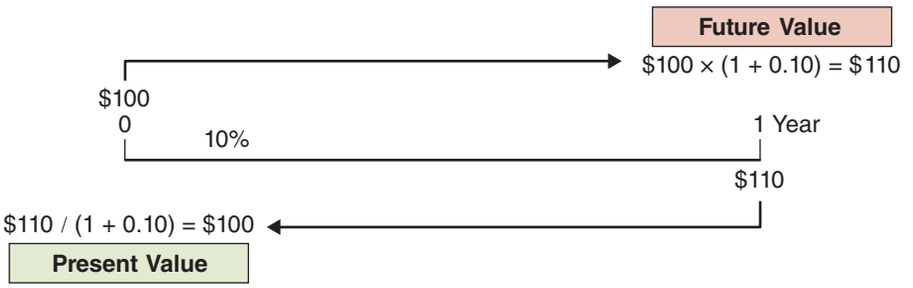


EXHIBIT 5.6 **Comparing Future Value and Present Value Calculations**

The future value and present value formulas are one and the same; the present value factor, $1/(1 + i)^n$, is just the reciprocal of the future value factor, $(1 + i)^n$.

Figure 5.20

Figure 5.21

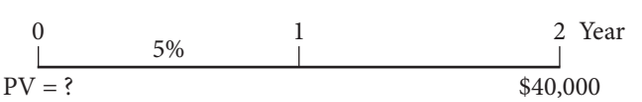
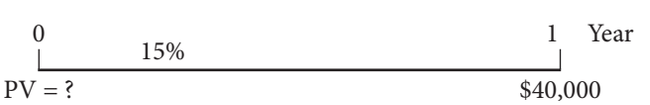


Figure 5.22

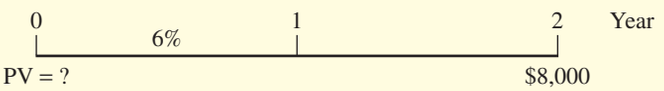


APPLICATION 5.3 | European Graduation Fling

LEARNING BY DOING

Problem Suppose you plan to take a vacation to Europe when you graduate from college in two years. If your savings account at the bank pays 6 percent, how much money do you need to set aside today to have $8,000 when you leave for Europe?

Approach The money you need today is the present value of the amount you will need for your trip in two years. The value of FV_2 is $8,000 and the interest rate is 6 percent. Using these values and the present value equation, we can calculate how much money you must put in the bank at 6 percent to generate $8,000. The time line is:



Solution

$$\begin{aligned} PV &= FV_n \times \frac{1}{(1+i)^n} \\ &= FV_2 \times \frac{1}{(1+i)^2} \\ &= \$8{,}000 \times \frac{1}{(1.06)^2} \\ &= \$8{,}000 \times 0.889996 \\ &= \$7{,}119.97 \end{aligned}$$

Thus, if you invest $7,119.97 in your savings account today, at the end of two years you will have exactly $8,000.

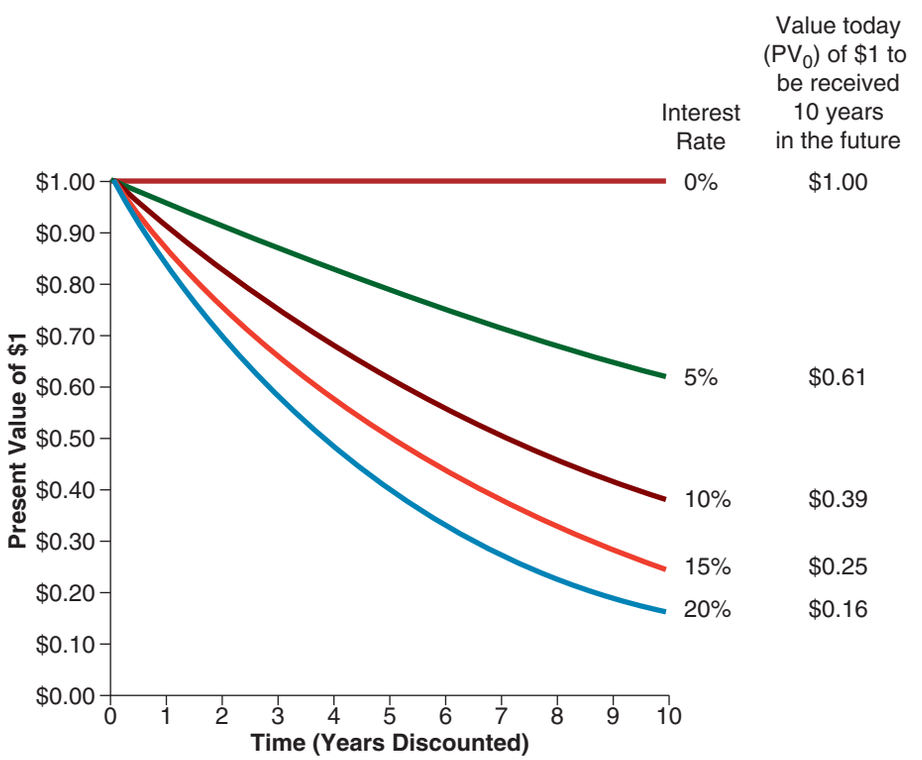


EXHIBIT 5.7 **Present Value of $1 for Different Time Periods and Discount Rates**

The higher the discount rate, the lower the present value of $1 for a given time period. Just as with future value, the relation between the present value and time is not linear, but exponential.

EXAMPLE 5.2 | Picking the Best Lottery Payoff Option

DECISION MAKING

Situation Congratulations! You have won the $1 million lottery grand prize. You have been presented with several payout alternatives, and you have to decide which one to accept. The alternatives are as follows:

- $1 million today
- $1.2 million lump sum in two years
- $1.5 million lump sum in five years
- $2 million lump sum in eight years

You are intrigued by the choice of collecting the prize money today or receiving double the amount of money in the future. Which payout option should you choose?

Your cousin, a stockbroker, advises you that over the long term you should be able to earn 10 percent on an investment portfolio. Based on that rate of return, you make the following calculations:

Alternative	Future Value	Present Value
Today	$1 million	$1 million
2 years	$1.2 million	$991,736
5 years	$1.5 million	$931,382
8 years	$2 million	$933,015

Decision As appealing as the higher amounts may sound, waiting for the big payout is not worthwhile in this case. Applying the present value formula has enabled you to convert future dollars into present, or current, dollars. Now the decision is simple—you can directly compare the present values. Given the choices here, you should take the $1 million today.

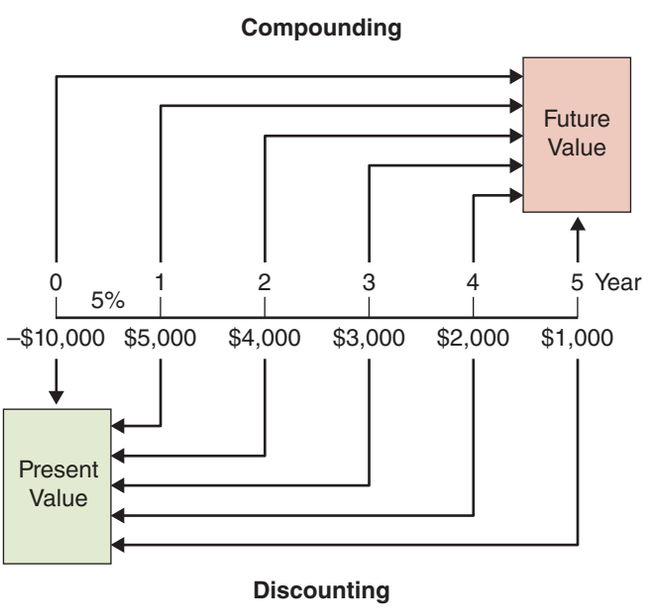


EXHIBIT 5.8 Future Value and Present Value Compared

Compounding converts a present value into its future value, taking into account the time value of money. Discounting is just the reverse—it converts future cash flows into their present value.

Figure 5.23

Figure 5.24

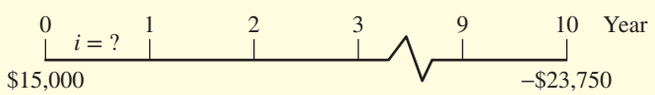
$$
\begin{aligned}
FV_n &= PV \times (1 + i)^n \\
\$1{,}000 &= \$90 \times (1 + i)^{20} \\
(1 + i)^{20} &= \frac{\$1{,}000}{\$90} \\
1 + i &= \left(\frac{\$1{,}000}{\$90}\right)^{1/20} \\
i &= (11.1111)^{1/20} - 1 \\
&= 1.1279 - 1 \\
&= 0.1279, \text{ or } 12.79\%
\end{aligned}
$$

LEARNING BY DOING

APPLICATION 5.4 | Interest Rate on a Loan

Problem Greg and Joan Hubbard are getting ready to buy their first house. To help make the down payment, Greg's aunt offers to loan them $15,000, which can be repaid in 10 years. If Greg and Joan borrow the money, they will have to repay Greg's aunt the amount of $23,750. What rate of interest would Greg and Joan be paying on the 10-year loan?

Approach In this case, the present value is the value of the loan ($15,000), and the future value is the amount due at the end of 10 years ($23,750). To solve for the rate of interest on the loan, we can use the future value equation, Equation 5.1. Alternatively, we can use a financial calculator to compute the interest rate. The time line for the loan, where the $15,000 is a cash inflow to Greg and Joan and the $23,750 is a cash outflow, is as follows:



Solution Using Equation 5.1:

$$
\begin{aligned}
FV_n &= PV \times (1 + i)^n \\
\$23{,}750 &= \$15{,}000 \times (1 + i)^{10} \\
(1 + i)^{10} &= \frac{\$23{,}750}{\$15{,}000} \\
1 + i &= \left(\frac{\$23{,}750}{\$15{,}000}\right)^{1/10} \\
i &= (1.58333)^{1/10} - 1 \\
&= 1.04703 - 1 \\
&= 0.04703, \text{ or } 4.703\%
\end{aligned}
$$

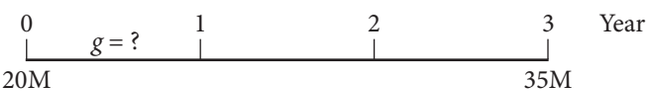
Using a financial calculator:

Enter	10		15,000	0	223,750
	N	i	PV	PMT	FV
Answer		**4.703**			

$$\text{TDM} = \frac{72}{i} \qquad (5.5)$$

$$\text{FV}_n = \text{PV} \times (1 + g)^n \qquad (5.6)$$

Figure 5.25



LEARNING BY DOING

APPLICATION 5.5 | The Growth Rate of the World's Population

Problem Hannah, an industrial relations major, is writing a term paper and needs an estimate of how fast the world population is growing. In her almanac, she finds that the world's population was an estimated 7.4 billion people as of August 2016. The United Nations estimates that the population will reach 11.2 billion people in August 2100. Calculate the annual population growth rate implied by these numbers. At that growth rate, what will be the world's population in August 2030?

Approach We first find the annual rate of growth through August 2100 by applying Equation 5.6 for the 84-year period 2016–2100. For the purpose of this calculation, we can use the estimated population of 7.4 billion people in 2016 as the present value, the estimated future population of 11.2 billion people as the future value, and 84 years as the number of compounding periods (n). We want to solve for g, which is the annual compound growth rate over the 84-year period. We can then plug the 84-year population growth rate in Equation 5.6 and solve for the world's population in August 2030 (FV_{14}). Alternatively, we can get the answer by using a financial calculator.

Solution Using Equation 5.6, we find the growth rate as follows:

$$\begin{aligned} \text{FV}_n &= \text{PV} \times (1 + g)^n \\ 11.2 &= 7.4 \times (1 + g)^{84} \\ 1.51 &= (1 + g)^{84} \\ (1.51)^{1/84} &= 1 + g \\ g &= (1.51)^{1/84} - 1 \\ &= 1.005 - 1 \\ &= 0.005, \text{ or } 0.5\% \end{aligned}$$

The world's population at the end of 2030 is therefore estimated to be:

$$\begin{aligned} \text{FV}_{14} &= 7.4 \times (1 + 0.005)^{14} \\ &= 7.4 \times 1.072 \\ &= 7.94 \text{ billion people} \end{aligned}$$

Using a financial calculator:

Enter	14	0.5	−7.4	0	
	N	i	PV	PMT	FV
Answer					**7.94**

APPLICATION 5.6 | Calculating Projected Earnings

LEARNING BY DOING

Problem IBM's net income in 2015 was $13.36 billion. Wall Street analysts expect IBM's earnings to increase by 6 percent per year over the next three years. Using your financial calculator, determine what IBM's earnings should be in three years.

Approach This problem involves the growth rate (g) of IBM's earnings. We already know the value of g, which is 6 percent, and we need to find the future value. Since the general compound growth rate formula, Equation 5.6, is the same as Equation 5.1, the future value formula, we can use the same calculator procedure we used earlier to find the future value. We enter the data on the calculator keys as shown below, using the growth rate value for the interest rate. Then we solve for the future value:

Solution

Enter	3	6	−13.3	0	
	N	i	PV	PMT	FV
Answer					**15.91**

Summary of Key Equations

Equation	Description	Formula
5.1	Future value of an n-period investment	$FV_n = PV \times (1 + i)^n$
5.2	Future value with more frequent than annual compounding	$FV_n = PV \times (1 + i/m)^{m \times n}$
5.3	Future value with continuous compounding	$FV_\infty = PV \times e^{i \times n}$
5.4	Present value of an n-period investment	$PV = \frac{FV_n}{(1 + i)^n}$
5.5	Rule of 72	$TDM = \frac{72}{i}$
5.6	Future value with general growth rate	$FV_n = PV \times (1 + g)^n$

Self-Study Problems

5.1 Amit Patel is planning to invest $10,000 in a bank certificate of deposit (CD) for five years. The CD will pay interest of 9 percent. What is the future value of Amit's investment?

5.2 Megan Gaumer expects to need $50,000 for a down payment on a house in six years. How much would she have to invest today in an account paying 7.25 percent in order to have $50,000 in six years?

5.3 Kelly Martin has $10,000 that she can deposit into a savings account for five years. Bank A compounds interest annually, Bank B twice a year, and Bank C quarterly. Each bank has a stated interest rate of 4 percent. What account balance would Kelly have at the end of the fifth year if she left all the interest paid on the deposit in each bank?

5.4 You have an opportunity to invest $2,500 today and receive $3,000 in three years. What would be the return on your investment if you accepted this opportunity?

5.5 Emily Smith deposits $1,200 in her bank today.

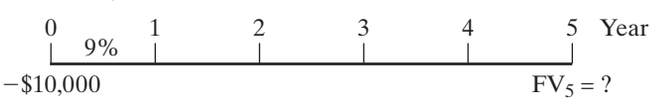
a. If the bank pays 4 percent interest per year without compounding, how much simple interest will she have earned and how much money will she have at the end of five years?

b. How much money will she have in five years if the bank pays compound interest with annual compounding?

c. How much of the earnings in part b, will be interest on interest?

Solutions to Self-Study Problems

5.1 Present value of Amit's investment = PV = $10,000
Interest rate = i = 9%
Number of years = n = 5

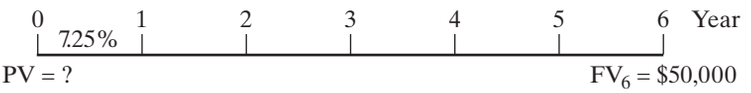


$FV_n = PV \times (1 + i)^n$

$FV_5 = \$10{,}000 \times (1 + 0.09)^5$

$= \$15{,}386.24$

5.2 Amount Megan will need in six years = FV_6 = \$50,000
Number of years = $n = 6$
Interest rate = $i = 7.25\%$
Amount that has to be invested now = PV = ?



$$PV = \frac{FV_n}{(1 + i)^n}$$

$$= \frac{\$50{,}000}{(1 + 0.0725)^6}$$

$= \$32{,}853.84$

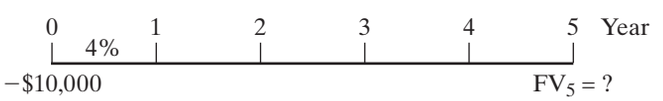
5.3 Present value of Kelly's deposit = PV = \$10,000
Number of years = $n = 5$
Interest rate = $i = 4\%$
Compound period (m):

A = 1

B = 2

C = 4

Amount at the end of five years = FV_5 = ?



Bank A: $FV_n = PV \times (1 + i/m)^{m \times n}$

$FV_5 = \$10{,}000 \times (1 + 0.04/1)^{1 \times 5}$

$= \$12{,}166.53$

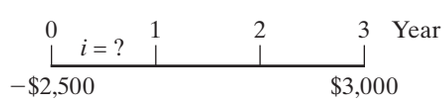
Bank B: $FV_5 = \$10{,}000 \times (1 + 0.04/2)^{2 \times 5}$

$= \$12{,}189.94$

Bank C: $FV_5 = \$10{,}000 \times (1 + 0.04/4)^{4 \times 5}$

$= \$12{,}201.90$

5.4 Your investment today = PV = \$2,500
Amount to be received = FV_3 = \$3,000
Time of investment = $n = 3$
Return on the investment = i = ?



$FV_n = PV \times (1 + i)^n$

$\$3{,}000 = \$2{,}500 \times (1 + i)^3$

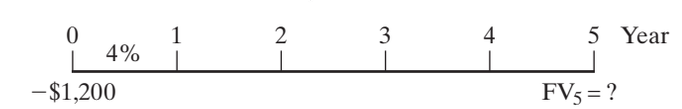
$$\frac{\$3{,}000}{\$2{,}500} = (1 + i)^3$$

$$i = \left(\frac{\$3{,}000}{\$2{,}500}\right)^{1/3} - 1$$

$i = 0.0627$, or 6.27%

5.5 Emily's deposit today = PV = \$1,200

a. Interest rate = $i = 4\%$
Number of years = $n = 5$
Amount to be received = FV_5 = ?



Future value with only simple interest
Simple interest per year = $1,200 × 0.04 = $48
Simple interest for 5 years = $48 × 5 years = $240
FV_5 = $1,200 + $240 = $1,440

b. Future value with compound interest and annual compounding
$FV_5 = \$1,200 \times (1 + 0.04)^5$
$= \$1,459.98$

c. Simple interest = $240
Interest on interest = $1,459.98 − $1,200 − $240 = $19.98

Discussion Questions

5.1 Explain the phrase "a dollar today is worth more than a dollar tomorrow."

5.2 Explain the importance of a time line.

5.3 What are the two factors to be considered in time value of money?

5.4 Explain the difference between future value and present value.

5.5 Explain the difference between compounding and discounting.

5.6 Explain how compound interest differs from simple interest.

5.7 If you were given a choice between investing in a savings account that paid quarterly interest and one that paid monthly interest, which one should you choose if they both offered the same stated interest rate and why?

5.8 Compound growth is exponential over time. Explain.

5.9 What is the Rule of 72?

5.10 You are planning to take a spring break trip to Cancun your senior year. The trip is exactly two years away, but you want to be prepared and have enough money when the time comes. Explain how you would determine the amount of money you will have to save in order to pay for the trip.

Questions and Problems

Basic

5.1 Future value: Chuck Tomkovick is planning to invest $25,000 today in a mutual fund that will provide a return of 8 percent each year. What will be the value of the investment in 10 years?

5.2 Future value: Ted Rogers is investing $7,500 in a bank CD that pays a 6 percent annual interest. How much will the CD be worth at the end of five years?

5.3 Future value: Your aunt is planning to invest in a bank CD that will pay 7.5 percent interest semiannually. If she has $5,000 to invest, how much will she have at the end of four years?

5.4 Future value: Kate Eden received a graduation present of $2,000 that she is planning on investing in a mutual fund that earns 8.5 percent each year. How much money will she have in three years?

5.5 Future value: Your bank pays 5 percent annual interest compounded semiannually on your savings account. You don't expect to add to the current balance of $2,700 over the next four years. How much money can you expect to have at the end of this period?

5.6 Future value: Your birthday is next week and instead of other presents, your parents promised to give you $1,000 in cash. Since you have a part-time job and, thus, don't need the cash immediately, you decide to invest the money in a bank CD that pays 5.2 percent, compounded quarterly, for the next two years. How much money can you expect to earn in this period of time?

5.7 Multiple compounding periods: Find the future value of a five-year $100,000 investment that pays 8.75 percent and that has the following compounding periods:

a. Quarterly.
b. Monthly.
c. Daily.
d. Continuous.

5.8 Growth rates: Joe Mauer, a catcher for the Minnesota Twins, is expected to hit 15 home runs in 2018. If his home-run-hitting ability is expected to grow by 12 percent every year for the following five years, how many home runs is he expected to hit in 2023?

5.9 Present value: Roy Gross is considering an investment that pays 7.6 percent, compounded annually. How much will he have to invest today so that the investment will be worth $25,000 in six years?

5.10 Present value: Maria Addai has been offered a future payment of $750 two years from now. If she can earn an annual rate of 6.5 percent, compounded daily, on her investment, what should she pay for this investment today?

5.11 Present value: Your brother has asked you for a loan and has promised to pay you $7,750 at the end of three years. If you normally invest to earn 6 percent per year, how much will you be willing to lend to your brother if you view this purely as a financial transaction (i.e., you don't give your brother a special deal)?

5.12 Present value: Tracy Chapman is saving to buy a house in five years. She plans to put 20 percent down at that time, and she believes that she will need $35,000 for the down payment. If Tracy can invest in a fund that pays 9.25 percent annual interest, compounded quarterly, how much will she have to invest today to have enough money for the down payment?

5.13 Present value: You want to buy some bonds that will have a value of $1,000 at the end of seven years. The bonds pay 4.5 percent interest annually. How much should you pay for them today?

5.14 Present value: Elizabeth Sweeney wants to accumulate $12,000 by the end of 12 years. If the annual interest rate is 7 percent and interest compounds semiannually, how much will she have to invest today to achieve her goal?

5.15 Interest rate: You are in desperate need of cash and turn to your uncle, who has offered to lend you some money. You decide to borrow $1,300 and agree to pay back $1,500 in two years. Alternatively, you could borrow from your bank that is charging 6.5 percent interest annually. Should you borrow from your uncle or the bank?

5.16 Number of periods: You invest $150 in a mutual fund today that pays 9 percent interest annually. How long will it take to double your money?

Intermediate

5.17 Future value: Your finance textbook sold 53,250 copies in its first year. The publishing company expects the sales to grow at a rate of 20 percent each year for the next three years and by 10 percent in the fourth year. Calculate the total number of copies that the publisher expects to sell in Years 3 and 4. Draw a time line to show the sales level for each of the next four years.

5.18 Future value: CelebNav, Inc., had sales last year of $700,000, and the analysts are predicting strong future performance for the start-up, with sales growing 20 percent a year for the next three years. After that, the sales should grow 11 percent per year for two years, at which time the owners are planning to sell the company. What are the projected sales for the last year before the sale?

5.19 Future value: You decide to take advantage of the current online dating craze and start your own Web site. You know that you have 450 people who will sign up immediately and, through a careful marketing research and analysis, determine that membership can grow by 27 percent in the first two years, 22 percent in Year 3, and 18 percent in Year 4. How many members do you expect to have at the end of four years?

5.20 Multiple compounding periods: Find the future value of an investment of $2,500 made today for the following rates and periods:

a. 6.25 percent compounded semiannually for 12 years.

b. 7.63 percent compounded quarterly for 6 years.

c. 8.9 percent compounded monthly for 10 years.

d. 10 percent compounded daily for 3 years.

e. 8 percent compounded continuously for 2 years.

5.21 Multiple compounding periods: Find the present value of $3,500 under each of the following rates and periods:

a. 8.9 percent compounded monthly for five years.

b. 6.6 percent compounded quarterly for eight years.

c. 4.3 percent compounded daily for four years.

d. 5.7 percent compounded continuously for three years.

5.22 Multiple compounding periods: Samantha plans to invest some money so that she has $5,500 at the end of three years. Determine how much should she invest today given the following choices:

a. 4.2 percent compounded daily.

b. 4.9 percent compounded monthly.

c. 5.2 percent compounded quarterly.

d. 5.4 percent compounded annually.

5.23 Time to grow: Zephyr Sales Company has sales of $1.125 million. If the company's management expects sales to grow 6.5 percent annually, how long will it be before sales double? Use a financial calculator to solve this problem.

5.24 Time to grow: You are going to deposit $850 in a bank CD today, and you will withdraw the money only once the balance is $1,000. If the bank pays 5 percent interest, how long will it take for the balance to reach $1,000?

5.25 Time to grow: Neon Lights Company is a private company with sales of $1.3 million a year. Management wants to take the company public but has to wait until the sales reach $2 million. If sales are expected to grow 12 percent annually, when is the earliest that Neon Lights will go public?

5.26 Time to grow: You have just inherited $550,000. You plan to save this money and continue to live off the money that you are earning in your current job. If you can invest the money in a bond that pays 4.6 percent interest annually, how long will it be before your inheritance is worth $1 million?

5.27 Growth rates: Xenix Corp had sales of $353,866 in 2017. If management expects its sales to be $476,450 in three years, what is the rate at which the company's sales are expected to grow?

5.28 Growth rate: Infosys Technologies, Inc., an Indian technology company, reported net income of $419 million this year. Analysts expect the company's earnings to be $1.468 billion in five years. What is the expected growth rate in the company's earnings?

5.29 Present value: Caroline Weslin needs to decide whether to accept a bonus of $1,820 today or wait two years and receive $2,100 then. She can invest at 6 percent. What should she do?

5.30 Present value: Congress and the President have decided to increase the federal tax rate in an effort to reduce the budget deficit. Suppose that Caroline Weslin, from problem 5.29, will pay 35 percent of her bonus to the federal government for taxes if she accepts the bonus today and 40 percent if she receives her bonus in two years. Will the increase in tax rates affect her decision?

Advanced

5.31 You have $2,500 that you want to invest in your classmate's start-up business. You believe the business idea to be great and expect to get $3,700 back at the end of three years. If all goes according to plan, what will be the return on your investment?

5.32 Patrick Seeley has $2,400 to invest. His brother approached him with an investment opportunity that could double his money in four years. What interest rate would the investment have to yield in order for Patrick's brother to deliver on his promise?

5.33 You have $12,000 in cash. You can deposit it today in a mutual fund earning 8.2 percent semiannually, or you can wait, enjoy some of it, and invest $11,000 in your brother's business in two years. Your brother is promising you a return of at least 10 percent on your investment. Whichever alternative you choose, you will need to cash in at the end of 10 years. Assume your brother is trustworthy and both investments carry the same risk. Which one would yield the larger amount in 10 years?

5.34 When you were born, your parents set up a bank account in your name with an initial investment of $5,000. You are turning 21 in a few days and will have access to all your funds. The account was earning 7.3 percent for the first seven years, but then the rates went down to 5.5 percent for six years. Your account then earned 8.2 percent three years in a row. Unfortunately, the next two years you earned only 4.6 percent. Finally, as the economy recovered, the return jumped to 7.6 percent for the last three years.

- **a.** How much money was in your account before the rates went down drastically at the end of Year 16?
- **b.** How much money is in your account now, at the end of Year 21?
- **c.** What would be the balance now if your parents made another deposit of $1,200 at the end of Year 7?

5.35 Jared Goff, the number 1 draft pick of the NFL Los Angeles Rams in 2016, and his agent are evaluating three contract options. Each option offers a signing bonus and a series of payments over the life of the contract. Goff uses a 10.25 percent rate of return to evaluate the contracts. Given the cash flows for each option, which one should he choose?

Year	Cash Flow Type	Option A	Option B	Option C
0	Signing Bonus	$3,100,000	$4,000,000	$4,250,000
1	Annual Salary	$ 650,000	$ 825,000	$ 550,000
2	Annual Salary	$ 715,000	$ 850,000	$ 625,000
3	Annual Salary	$ 822,250	$ 925,000	$ 800,000
4	Annual Salary	$ 975,000	$1,250,000	$ 900,000
5	Annual Salary	$1,100,000		$1,000,000
6	Annual Salary	$1,250,000		

5.36 Surmec, Inc., reported sales of $2.1 million last year. The company's primary business is the manufacture of nuts and bolts. Since this is a mature industry, analysts are confident that sales will grow at a steady rate of 7 percent per year. The company's net income equals 23 percent of sales. Management would like to buy a new fleet of trucks but can only do so once the net income reaches $620,000 a year. At the end of what year will Surmec be able to buy the trucks? What will sales and net income be in that year?

5.37 You will be graduating in two years and are thinking about your future. You know that you will want to buy a house five years after you graduate and that you will want to put down $60,000. As of right now, you have $8,000 in your savings account. You are also fairly certain that once you graduate, you can work in the family business and earn $32,000 a year, with a 5 percent raise every year. You plan to live with your parents for the first two years after graduation, which will enable you to minimize your expenses and put away $10,000 each year. The next three years, you will have to live on your own as your younger sister will be graduating from college and has already announced her plan to move back into the family house. Thus, you will be able to save only 13 percent of your annual salary. Assume that you will be able to earn 7.2 percent on the savings from your salary. At what interest rate will you need to invest the current savings account balance in order to achieve your goal? *Hint:* Draw a time line that shows all the cash flows for years 0 through 7. Remember, you want to buy a house seven years from now and your first salary will be in Year 3.

Sample Test Problems

5.1 Holding all else constant, what will happen to the present value of a future amount if you increase the discount rate? What if you increase the number of years?

5.2 Juliette Bronson anticipates needing $500,000 to start a business. If she can earn 4.5 percent compounded annually on her investments, how much money would Juliette have to invest today to have $500,000 in three years?

5.3 Christopher Thompkins must decide how to invest $10,000 that he just inherited. What would be the future value of his investment after five years under each of the following three investment opportunities?

- **a.** 6.28 percent compounded quarterly.
- **b.** 6.20 percent compounded monthly.
- **c.** 6.12 percent compounded continuously.

5.4 Tina DeLeon deposited $2,500 today in an account paying 6 percent interest annually. What would be the simple interest earned on this investment in five years? With annual compounding, how much interest on interest would Tina earn in five years?

5.5 The state of Texas had 42,725 active patient care physicians in 2013 and by 2017 this number had grown to 47,663. What was the compound annual growth rate (CAGR) in the number of active care physicians during this period?

Solutions to Odd Problems

Chapter 5

1. $53,973.12

3. $6,712.35

5. $3,289.69

7. **a.** $154,154.24; **b.** $154,637.37; **c.** $154,874.91; **d.** $154,883.03

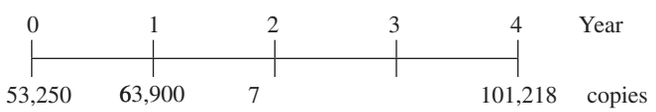
9. $16,108.92

11. $6,507.05

13. $734.83

15. 7.42%; you should borrow from the bank.

17. 92,016 copies; 101,218 copies



19. 1,045 members

21. **a.** $2,246.57; **b.** $2,073.16; **c.** $2,946.96; **d.** $2,949.88

23. 11 years

25. 3.8 years

27. 10.42%

29. $1,868.99; since $1,868.99 is greater than $1,820, Caroline should wait two years unless she needs the money sooner.

31. 13.96%

33. Option 1 (mutual fund): $26,803.77; Option 2 (brother's business): $23,579.48; you should choose the mutual fund.

5.35 Option A: $6,922,647; Option B: $6,983,894; Option C: $7,083,096; Jared should choose Option C.

5.37 13.14%

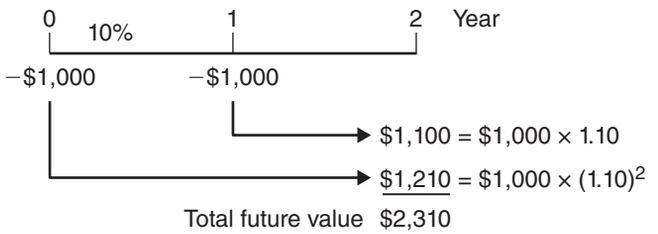


EXHIBIT 6.1 **Future Value of Two Cash Flows**

This exhibit shows a time line for two cash flows invested in a savings account that pays 10 percent interest annually. The total amount in the savings account after two years is $2,310, which is the sum of the future values of the two cash flows.

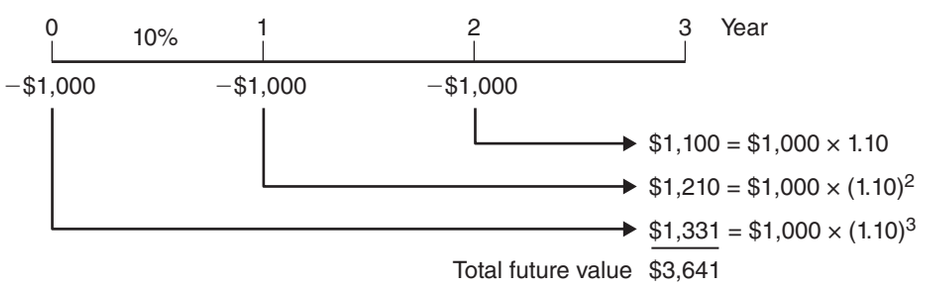


EXHIBIT 6.2 **Future Value of Three Cash Flows**

The exhibit shows a time line for an investment program with a three-year horizon. The value of the investment at the end of three years is $3,641, the sum of the future values of the three separate cash flows.

Figure 6.1

$$FV_1 = PV \times (1 + i) = \$1{,}000 \times (1 + 0.10) = \$1{,}000 \times 1.100 = \$1{,}100$$
$$FV_2 = PV \times (1 + i)^2 = \$1{,}000 \times (1 + 0.10)^2 = \$1{,}000 \times 1.210 = \$1{,}210$$
$$FV_3 = PV \times (1 + i)^3 = \$1{,}000 \times (1 + 0.10)^3 = \$1{,}000 \times 1.331 = \underline{\$1{,}331}$$
Total future value $3,641

Figure 6.2

The time line for the future value calculation in this problem looks like this:

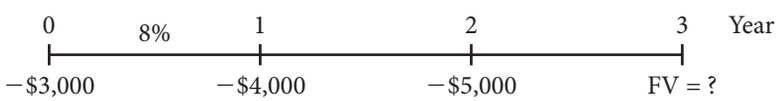


Figure 6.3

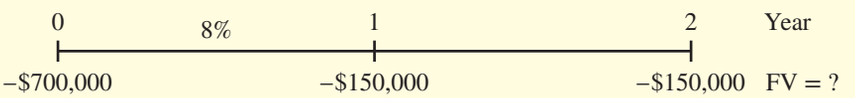
$$FV_1 = PV \times (1 + i) = \$5{,}000 \times 1.08 = \$5{,}000 \times 1.0800 = \$\ 5{,}400.00$$
$$FV_2 = PV \times (1 + i)^2 = \$4{,}000 \times (1.08)^2 = \$4{,}000 \times 1.1664 = \$\ 4{,}665.60$$
$$FV_3 = PV \times (1 + i)^3 = \$3{,}000 \times (1.08)^3 = \$3{,}000 \times 1.2597 = \underline{\$\ 3{,}779.14}$$
Total future value $13,844.74

LEARNING BY DOING

APPLICATION 6.1 | Bidding on a Contract to Rebuild a Bridge

Problem The firm you work for is considering bidding on a contract to rebuild an old bridge that has reached the end of its useful life. The two-year contract will pay the firm $1,100,000 at the end of the second year. The firm's estimator believes that the project will require an initial expenditure of $700,000 for equipment. The expenses for Years 1 and 2 are estimated at $150,000 per year. Because the cash inflow of $1,100,000 at the end of the contract exceeds the total cash outflows of $1,000,000 ($700,000 + $150,000 + $150,000 = $1,000,000), the estimator believes that the firm should accept the job. Drawing on your knowledge of finance from college, you point out that the estimator's decision process ignores the time value of money. Not fully understanding what you mean, the estimator asks you how the time value of money should be incorporated into the decision process. Assume that the appropriate interest rate is 8 percent.

Approach First, construct the time line for the costs in this problem, as shown here:



Second, use Equation 5.1 to convert each of the cash outflows into Year 2 dollars. This will make all the cash flows comparable. Finally, compare the sum of the cash outflows, stated in Year 2 dollars, to the $1,100,000 that you would receive under the contract in Year 2.

Solution

$$FV_2 = PV \times (1 + i)^2 = -\$700{,}000 \times (1.08)^2 = -\$700{,}000 \times 1.1664 = -\$\ 816{,}480$$
$$FV_1 = PV \times (1 + i) = -\$150{,}000 \times 1.08 = -\$150{,}000 \times 1.0800 = -\$\ 162{,}000$$
$$FV_0 = PV \times (1 + i)^0 = -\$150{,}000 \times (1.08)^0 = -\$150{,}000 \times 1.0000 = -\$\ 150{,}000$$
$$\text{Total net future value} \quad -\$1{,}128{,}480$$

Once the future value calculations have been made, the decision is self-evident. With all the dollars stated as Year 2 dollars, the cash inflow (benefits) is $1,100,000 and the cash outflow (costs) is $1,128,480. Thus, the costs exceed the benefits, and the firm's management should reject the contract. If management accepts the contract, the value of the firm will decline by $28,480 ($1,100,000 − $1,128,480 = −$28,480).

Figure 6.4

$$PV = FV_1 \times 1/(1 + i) = FV \times 1/1.07 = \$1{,}000 \times 0.9346 = \$ \ 934.58$$
$$PV = FV_2 \times 1/(1 + i)^2 = FV_2 \times 1/(1.07)^2 = \$1{,}000 \times 0.8734 = \$ \ 873.44$$
$$PV = FV_3 \times 1/(1 + i)^3 = FV_3 \times 1/(1.07)^3 = \$1{,}000 \times 0.8163 = \$ \ 816.30$$
Total present value $2,624.32

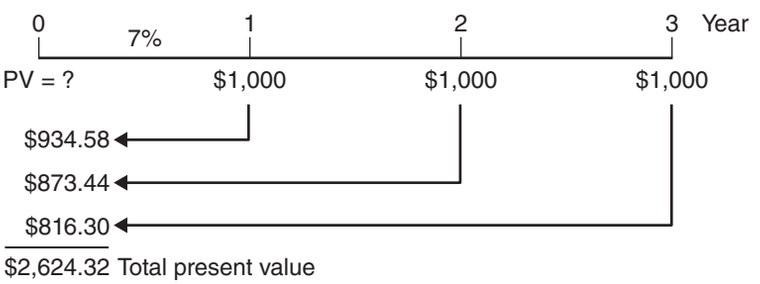


EXHIBIT 6.3 **Present Value of Three Cash Flows**

This exhibit shows the time line for a three-year loan with a payment of $1,000 at the end of each year and an annual interest rate of 7 percent. To calculate the value of the loan today, we compute the present value of each of the three cash flows and then add them up. The present value of the loan is $2,624.32.

Figure 6.5

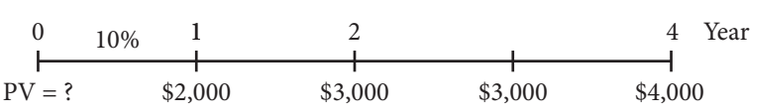


Figure 6.6

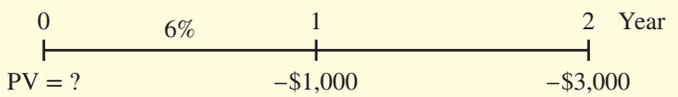
$$PV = FV_1 \times 1/(1 + i) = \$2{,}000 \times 1/1.10 = \$2{,}000 \times 0.9091 = \$1{,}818.18$$
$$PV = FV_2 \times 1/(1 + i)^2 = \$3{,}000 \times 1/(1.10)^2 = \$3{,}000 \times 0.8264 = \$2{,}479.34$$
$$PV = FV_3 \times 1/(1 + i)^3 = \$3{,}000 \times 1/(1.10)^3 = \$3{,}000 \times 0.7513 = \$2{,}253.94$$
$$PV = FV_4 \times 1/(1 + i)^4 = \$4{,}000 \times 1/(1.10)^4 = \$4{,}000 \times 0.6830 = \$2{,}732.05$$
Total present value $9,283.51

APPLICATION 6.2 | The Value of a Gift to the University

LEARNING BY DOING

Problem Suppose that in your senior year, as part of the senior class gift campaign, you pledge to donate to your university $1,000 per year for four years and $3,000 for the fifth year, for a total of $7,000. Immediately after making the third payment, you decide to make a payment with a value equal to the present value of the final two payments of your pledge because your financial situation has improved. How much should you pay to the university if the interest rate is 6 percent?

Approach The key to understanding this problem is recognizing the need for a present value calculation. Because your pledge to the university is for future cash payments, the value of the amount you will pay for the remaining two years is worth less than the $4,000 ($1,000 + $3,000 = $4,000) you promised. If the appropriate discount rate is 6 percent, the time line for the cash payments for the remaining two years of the pledge is as follows:



We now need only calculate the present value of the last two payments.

Solution The present value calculation for the last two payments is:

$$\begin{aligned} PV = CF_1 \times 1/(1+i) &= -\$1{,}000 \times 1/1.06 &&= -\$\ \ 943.40 \\ PV = CF_2 \times 1/(1+i)^2 &= -\$3{,}000 \times 1/(1.06)^2 &&= \underline{-\$2{,}669.99} \\ &\qquad\qquad \text{Total present value} && -\$3{,}613.39 \end{aligned}$$

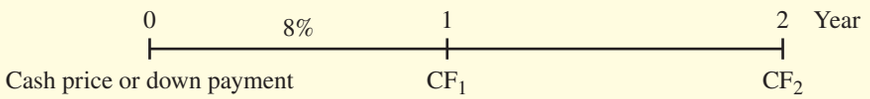
A payment of $3,613.39 to the university today (the end of Year 3) is a fair payment because at a 6 percent interest rate, it has precisely the same value as paying the university $1,000 at the end of Year 4 and $3,000 at the end of Year 5. In other words, if you pay the university $3,613.39 and the university invests that amount at 6 percent in a bank, it will be able to withdraw $1,000 in one year and $3,000 in two years.

APPLICATION 6.3 | Buying a Used Car—Help!

LEARNING BY DOING

Problem For a student—or anyone else—buying a used car can be a harrowing experience. Once you find the car you want, the next difficult decision is choosing how to pay for it—cash or a loan. Suppose the cash price you have negotiated for the car is $5,600, but that amount will stretch your budget for the year. The dealer says, "No problem. The car is yours for $4,000 down and payments of $1,000 per year for the next two years. Or you can put $2,000 down and pay $2,000 per year for two years. The choice is yours." Which offer is the best deal if the interest rate you can earn on your money is 8 percent?

Approach In this problem, there are three alternative streams of cash flows. We need to convert all of the cash flows (CF_n) into today's dollars (present value) and select the alternative with the lowest present value (price). The time line for the three alternatives, along with the cash flows for each, is as follows:



The cash flows at time zero represent the cash price of the car in the case of Alternative A and the down payment in the cases of Alternatives B and C.

	Cash Price or Down Payment	CF_1	CF_2	Total
Alternative A	−$5,600	—	—	−$5,600
Alternative B	−$4,000	−$1,000	−$1,000	−$6,000
Alternative C	−$2,000	−$2,000	−$2,000	−$6,000

Now we can use Equation 5.4 to find the present value of each alternative.

Solution

Alternative A:

$$-\$5{,}600 \times 1/(1.08)^0 = -\$5{,}600.00$$

Alternative B:

$$-\$4{,}000 \times 1/(1.08)^0 = -\$4{,}000.00$$
$$-\$1{,}000 \times 1/1.08 = -\$\ 925.93$$
$$-\$1{,}000 \times 1/(1.08)^2 = -\$\ 857.34$$
$$\text{Total} \quad -\$5{,}783.27$$

Alternative C:

$$-\$2{,}000 \times 1/(1.08)^0 = -\$2{,}000.00$$
$$-\$2{,}000 \times 1/1.08 = -\$1{,}851.85$$
$$-\$2{,}000 \times 1/(1.08)^2 = -\$1{,}714.68$$
$$\text{Total} \quad -\$5{,}566.53$$

Once we have converted the three cash flow streams to present values, the answer is clear. Alternative C has the lowest cost, in present value terms, and is the alternative you should choose.

DECISION MAKING

EXAMPLE 6.1 | The Investment Decision

Situation You are thinking of buying a business, and your investment adviser presents you with two possibilities. Both businesses are priced at $60,000, and you have only $60,000 to invest. She has provided you with the following annual and total cash flows for each business, along with the present value of the cash flows discounted at 10 percent:

	Cash flow ($ thousands)				
Business	**1**	**2**	**3**	**Total**	**PV at 10%**
A	$50	$30	$ 20	$100	$85.27
B	$ 5	$ 5	$100	$110	$83.81

Which business should you acquire?

Decision At first glance, Business B may look to be the best choice because its undiscounted cash flows for the three years total $110,000, versus $100,000 for A. However, to make the decision on the basis of the undiscounted cash flows ignores the time value of money. By discounting the cash flows, we convert them to current dollars, or their present values. The present value of Business A is $85,270 and that of B is $83,810. While both of these investment opportunities are attractive, you should acquire Business A if you only have $60,000 to invest. Business A is expected to produce more valuable cash flows for your investment.

Figure 6.7

$$\begin{aligned}
\text{PVA}_3 &= \left[\text{CF}_1 \times \frac{1}{1+i}\right] + \left[\text{CF}_2 \times \frac{1}{(1+i)^2}\right] + \left[\text{CF}_3 \times \frac{1}{(1+i)^3}\right] \\
&= \left[\$2{,}000 \times \frac{1}{1.08}\right] + \left[\$2{,}000 \times \frac{1}{(1.08)^2}\right] + \left[\$2{,}000 \times \frac{1}{(1.08)^3}\right] \\
&= \$1{,}851.85 + \$1{,}714.68 + \$1{,}587.66 \\
&= \$5{,}154.19
\end{aligned}$$

Figure 6.8

$$\text{PVA}_n = \left[\text{CF} \times \frac{1}{1+i}\right] + \left[\text{CF} \times \frac{1}{(1+i)^2}\right] + \cdots + \left[\text{CF} \times \frac{1}{(1+i)^n}\right]$$

$$\text{PVA}_n = \frac{\text{CF}}{i} \times \left[1 - \frac{1}{(1+i)^n}\right] \qquad (6.1)$$

$$= \text{CF} \times \left[\frac{1 - 1/(1+i)^n}{i}\right]$$

Figure 6.9

$$\text{PVA}_n = \text{CF} \times \frac{1 - \text{Present value factor}}{i}$$

Figure 6.10

$$\text{PV annuity factor} = \frac{1 - \text{Present value factor}}{i}$$

Figure 6.11

$$\text{PVA}_n = \text{CF} \times \text{PV annuity factor}$$

Figure 6.12

$$\begin{aligned}\text{Present value factor} &= \frac{1}{(1+i)^n} \\ &= \frac{1}{(1+0.08)^3} \\ &= \frac{1}{(1.08)^3} \\ &= \frac{1}{1.2597} \\ &= 0.7938\end{aligned}$$

Figure 6.13

$$\begin{aligned}\text{PV annuity factor} &= \frac{1 - \text{Present value factor}}{i} \\ &= \frac{1 - 0.7938}{0.08} \\ &= 2.577\end{aligned}$$

Figure 6.14

$$\begin{aligned} PVA_3 &= CF \times PV \text{ annuity factor} \\ &= \$2{,}000 \times 2.577 \\ &= \$5{,}154.00 \end{aligned}$$

Figure 6.15

Enter	3	8		2,000	0
	N	i	PV	PMT	FV
Answer			**−5,154.19**		

LEARNING BY DOING

APPLICATION 6.4 | Computing a PV Annuity Factor

Problem Compute the PV annuity factor for 30 years at a 10 percent interest rate.

Approach First, we calculate the present value factor at 10 percent for 30 years. Then, using this value, we calculate the PV annuity factor.

Solution

$$\begin{aligned} \text{Present value factor} &= \frac{1}{(1+i)^n} \\ &= \frac{1}{(1.10)^{30}} \\ &= \frac{1}{17.4494} \\ &= 0.0573 \end{aligned}$$

Using this value, we calculate the PV annuity factor to be:

$$\begin{aligned} \text{PV annuity factor} &= \frac{1 - \text{Present value factor}}{i} \\ &= \frac{1 - 0.0573}{0.10} \\ &= 9.427 \end{aligned}$$

We worked through the tedious calculations to show where the numbers come from and how the calculations are made. Financial analysts typically use financial calculators or spreadsheet programs for these calculations. You might check the answer to this problem using your calculator.

Figure 6.16

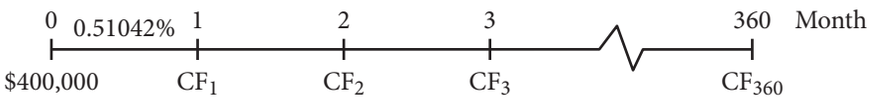


Figure 6.17

$$\begin{aligned}\text{Present value factor} &= \frac{1}{(1+i)^n} \\ &= \frac{1}{(1.0051042)^{360}} \\ &= \frac{1}{6.25160595} \\ &= 0.1599589\end{aligned}$$

Figure 6.18

$$\begin{aligned}\text{PV annuity factor} &= \frac{1 - \text{Present value factor}}{i} \\ &= \frac{1 - 0.1599589}{0.0051042} \\ &= \frac{0.8400411}{0.0051042} \\ &= 164.578406\end{aligned}$$

Figure 6.19

$$\begin{aligned}\text{PVA}_n &= \text{CF} \times \text{PV annuity factor} \\ \$400{,}000 &= \text{CF} \times 164.578406 \\ \text{CF} &= \frac{\$400{,}000}{164.578406} \\ \text{CF} &= \$2{,}430.45\end{aligned}$$

Figure 6.20

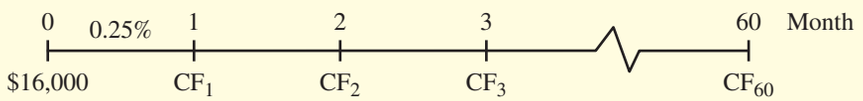
Enter	**360**	**0.51042**	**400,000**		**0**
	N	**i**	**PV**	**PMT**	**FV**
Answer				**−2,430.44**	

LEARNING BY DOING

APPLICATION 6.5 | What Are Your Monthly Car Payments?

Problem You have decided to buy a new car, and the dealer's best price is $16,000. The dealer agrees to provide financing with a five-year auto loan at 3 percent interest. Using a financial calculator, calculate your monthly payments.

Approach All the problem data must be converted to monthly terms. The number of periods is 60 months (5 years × 12 months per year = 60 months), and the monthly interest charge is 0.25 percent (3 percent per year/12 months per year = 0.25 percent per month). The time line for the car purchase is as follows:



Having converted our data to monthly terms, we enter the following values into the calculator: N = 60 months, i = 0.25, PV = $16,000, and FV = 0 (to clear the register). Pressing the payment key (PMT) will give us the answer.

Solution

Enter		**0.25**	**16,000**		**0**
	N	**i**	**PV**	**PMT**	**FV**
Answer				**−287.50**	

Note that since we entered $16,000 as a positive number (because it is a cash inflow to you), the monthly payment of $287.50 is a negative number.

Figure 6.21

$$\text{PVA}_n = \text{CF} \times \left[\frac{1 - 1/(1+i)^n}{i}\right]$$

$$\$10{,}000 = \text{CF} \times \left[\frac{1 - 1/(1+0.05)^5}{0.05}\right]$$

$$\$10{,}000 = \text{CF} \times 4.329$$

$$\text{CF} = \frac{\$10{,}000}{4.329}$$

$$\text{CF} = \$2{,}310.00 \text{ per year}$$

Figure 6.22

$$\begin{aligned}\text{Interest payment} &= i \times P_0 \\ &= 0.05 \times \$10{,}000 \\ &= \$500\end{aligned}$$

Year	Beginning Principal Balance (1)	Total Annual Payment[a] (2)	Interest Paid[b] (3)	Principal Paid (2)–(3) (4)	Ending Principal Balance (1)–(4) (5)
1	$10,000.00	$2,309.75	$500.00	$1,809.75	$8,190.25
2	8,190.25	2,309.75	409.51	1,900.24	6,290.02
3	6,290.02	2,309.75	314.50	1,995.25	4,294.77
4	4,294.77	2,309.75	214.74	2,095.01	2,199.76
5	2,199.76	2,309.75	109.99	2,199.76	0.00

[a]The total annual payment is calculated using the formula for the present value of an annuity, Equation 6.1. The total annual payment is CF in PVA_n = CF × PV annuity factor.

[b]Interest paid equals the beginning balance times the interest rate.

EXHIBIT 6.4 Amortization Table for a Five-Year, $10,000 Loan with an Interest Rate of 5 Percent

A loan amortization table shows how regular payments of principal and interest are applied to repay a loan. The exhibit is an amortization table for a five-year, $10,000 loan with an interest rate of 5 percent and annual payments of $2,309.75. Notice that the interest paid declines with each payment, while the principal paid increases.

Figure 6.23

$$\begin{aligned}\text{Interest payment} &= i \times P_1 \\ &= 0.05 \times \$8{,}190.25 \\ &= \$409.51\end{aligned}$$

Using Excel

Loan Amortization Table

Loan amortization tables are most easily constructed using a spreadsheet program. Here, we have reconstructed the loan amortization table shown in Exhibit 6.4 using Excel.

Notice that all the values in the amortization table are obtained by using formulas. Once you have built an amortization table like this one, you can change any of the input variables, such as the loan amount or the interest rate, and all of the other numbers will automatically be updated.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1													
2							Loan Amortization Table						
3													
4		Loan amount		$10,000									
5		Interest rate		0.05									
6		Loan period		5									
7		**PMT**		**$2,309.75**									
8													
9		**Year**		**Beginning Balance**		**Total Annual Payment**		**Simple Interest Paid**		**Principal Paid**		**Ending Balance**	
10		1		$10,000.00		$2,309.75		$500.00		$1,809.75		$8,190.25	
11		2		8,190.25		2,309.75		409.51		1,900.24		6,290.02	
12		3		6,290.02		2,309.75		314.50		1,995.25		4,294.77	
13		4		4,294.77		2,309.75		214.74		2,095.01		2,199.76	
14		5		2,199.76		2,309.75		109.99		2,199.76		0.00	
15													
16	**Corresponding formulas:**												
17													
18		**PMT**		=PMT(D5, D6, -D4)									
19													
20		**Year**		**Beginning Balance**		**Total Annual Payment**		**Simple Interest Paid**		**Principal Paid**		**Ending Balance**	
21		1		=D4		=$D$7		=D10*$D$5		=F10-H10		=D10-J10	
22		2		=L10		=$D$7		=D11*$D$5		=F11-H11		=D11-J11	
23		3		=L11		=$D$7		=D12*$D$5		=F12-H12		=D12-J12	
24		4		=L12		=$D$7		=D13*$D$5		=F13-H13		=D13-J13	
25		5		=L13		=$D$7		=D14*$D$5		=F14-H14		=D14-J14	
26													

Figure 6.24

$$\text{PVA}_n = \text{CF} \times \left[\frac{1 - 1/(1+i)^n}{i}\right]$$

$$\$350{,}000 = \$50{,}000 \times \left[\frac{1 - 1/(1+i)^{10}}{i}\right]$$

Figure 6.25

$$\begin{aligned}\text{PVA} &= \$50{,}000 \times \frac{1 - 1/(1+0.05)^{10}}{0.05} \\ &= \$50{,}000 \times 7.722 \\ &= \$386{,}100\end{aligned}$$

Figure 6.26

$$\begin{aligned}\text{PVA} &= \$50{,}000 \times \frac{1 - 1/(1 + 0.07)^{10}}{0.07} \\ &= \$50{,}000 \times 7.024 \\ &= \$351{,}200\end{aligned}$$

Figure 6.27

$$\begin{aligned}\text{PVA} &= \$50{,}000 \times \frac{1 - 1(1 + 0.071)^{10}}{0.071} \\ &= \$50{,}000 \times 6.991 \\ &= \$349{,}550\end{aligned}$$

Figure 6.28

$$\begin{aligned}\text{PVA} &= \$50{,}000 \times \frac{1 - 1/(1 + 0.0707)^{10}}{0.0707} \\ &= \$50{,}000 \times 7.001 \\ &= \$350{,}050\end{aligned}$$

Figure 6.29

$$\begin{aligned}\text{PVA} &= \$50{,}000 \times \frac{1 - 1/(1 + 0.07073)^{10}}{0.07073} \\ &= \$50{,}000 \times 7.000 \\ &= \$350{,}000\end{aligned}$$

Figure 6.30

Enter			**−350,000**	**50,000**	**0**
	N	**i**	**PV**	**PMT**	**FV**
Answer		**7.073**			

Using Excel

Calculating the Interest Rate For an Annuity

You can also solve for the interest rate using the =RATE function in Excel as illustrated below.

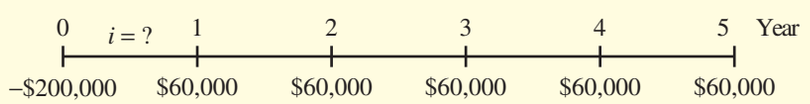
<>	A	B	C	D	E	F
1						
2		N		10		
3		PMT		$50,000		
4		PV		–$350,000		
5		FV		$0		
6						
7		Interest Rate		7.073%		
8		Formula		= RATE(D2,D3,D4,D5)		
9						

LEARNING BY DOING

APPLICATION 6.6 | Return on Investments: Good Deal or Bad?

Problem With some business opportunities you know the price of a financial contract and the promised cash flows, and you want to calculate the interest rate or rate of return on the investment. For example, suppose you have a chance to invest in a small business. The owner wants to borrow $200,000 from you for five years and will make yearly payments of $60,000 at the end of each year. Similar types of investment opportunities will pay 5 percent. Is this a good investment opportunity?

Approach First, we draw a time line for this loan:



To compute the rate of return on the investment, we need to compute the interest rate that equates the initial investment of $200,000 to the present value of the promised cash flows of $60,000 per year. We can use the trial-and-error approach with Equation 6.1, a financial calculator, or a spreadsheet program (for example, using the RATE function in Excel) to solve this problem. Here we will use a financial calculator.

Solution The financial calculator steps are:

Enter	**5**		**–200,000**	**60,000**	**0**
	N	**i**	**PV**	**PMT**	**FV**
Answer		**15.24**			

The return on this investment is 15.24 percent, well above the market interest rate of 5 percent. It is a good investment opportunity.

DECISION MAKING

EXAMPLE 6.2 | The Pizza Dough Machine

Situation As the owner of a pizza parlor, you are considering whether to buy a fully automated pizza dough preparation machine. Your staff is wildly supportive of the purchase because it would eliminate a tedious part of their work. Your accountant provides you with the following information:

- The cost, including shipping, for the pizza dough machine is $25,000.
- Cash savings, including labor, raw materials, and tax savings due to depreciation, are $3,500 per year for 10 years.
- The present value of the cash savings is $21,506 at a 10 percent discount rate.[2]

Given the above data, what should you do?

Decision As you arrive at the pizza parlor in the morning, the staff is in a festive mood because word has leaked out that the new machine will save the shop $35,000 and only cost $25,000.

With a heavy heart, you explain that the analysis done at the water cooler by some of the staff is incorrect. To make economic decisions involving cash flows, even for a small business such as your pizza parlor, you cannot compare cash values from different time periods unless they are adjusted for the time value of money. The present value formula takes into account the time value of money and converts the future cash flows into current dollars. The cost of the machine is already in current dollars.

The correct analysis is as follows: the machine costs $25,000, and the present value of the cost savings is $21,506. Thus, the cost of the machine exceeds the benefits; the correct decision is not to buy the new dough preparation machine.

$$
\begin{aligned}
\mathrm{FVA}_n &= \mathrm{PVA}_n \times (1+i)^n \qquad (6.2)\\
&= \frac{\mathrm{CF}}{i} \times \left[1 - \frac{1}{(1+i)^n}\right] \times (1+i)^n\\
&= \frac{\mathrm{CF}}{i} \times [(1+i)^n - 1]\\
&= \mathrm{CF} \times \left[\frac{(1+i)^n - 1}{i}\right]
\end{aligned}
$$

Figure 6.31

$$
\begin{aligned}
\mathrm{FVA}_n &= \mathrm{CF} \times \left[\frac{(1+i)^n - 1}{i}\right]\\
&= \mathrm{CF} \times \frac{\text{Future value factor} - 1}{i}\\
&= \mathrm{CF} \times \text{FV annuity factor}
\end{aligned}
$$

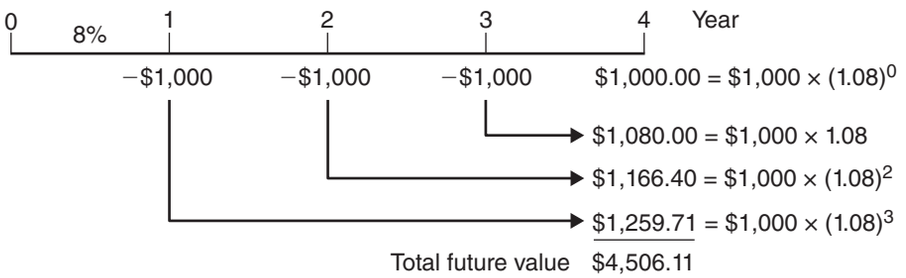


EXHIBIT 6.5 **Future Value of a Four-Year Annuity: Colnago C60 Bicycle**

The exhibit shows a time line for a savings plan to buy a Colnago C60 bicycle. Under this savings plan, $1,000 is invested at the end of each year for four years at an annual interest rate of 8 percent. We find the value at the end of the four-year period by adding the future values of the separate cash flows, just as in Exhibits 6.1 and 6.2.

Figure 6.32

$$\text{Future value factor} = (1 + i)^n = (1.08)^4 = 1.36049$$

$$\text{FV annuity factor} = \frac{\text{Future value factor} - 1}{i} = \frac{1.36049 - 1}{0.08} = 4.5061$$

Figure 6.33

$$\text{FVA}_n = \text{CF} \times \text{FV annuity factor} = \$1{,}000 \times 4.5061 = \$4{,}506.10$$

Figure 6.34

Enter		**8**	**0**	**−1000**	
	N	**i**	**PV**	**PMT**	**FV**
Answer					**4,506.11**

$$\text{PVP} = \frac{\text{CF}}{i} \times \left[1 - \frac{1}{(1+i)^{\infty}}\right] \tag{6.3}$$
$$= \frac{\text{CF}}{i} \times [1 - 0]$$
$$= \frac{\text{CF}}{i}$$

Figure 6.35

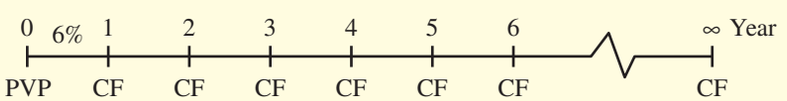
$$\text{PVP} = \frac{\text{CF}}{i} = \frac{\$100{,}000}{0.08} = \$1{,}250{,}000$$

APPLICATION 6.7 | Preferred Stock Dividends

LEARNING BY DOING

Problem Suppose that you are the CEO of a public company and your investment banker recommends that you issue some preferred stock at $50 per share. Similar preferred stock issues are yielding 6 percent. What annual cash dividend does the firm need to offer to be competitive in the marketplace? In other words, what cash dividend paid annually forever would be worth $50 with a 6 percent discount rate?

Approach As we have already mentioned, preferred stock is a type of perpetuity; thus, we can solve this problem by applying Equation 6.3. As usual, we begin by laying out the time line for the cash flows:



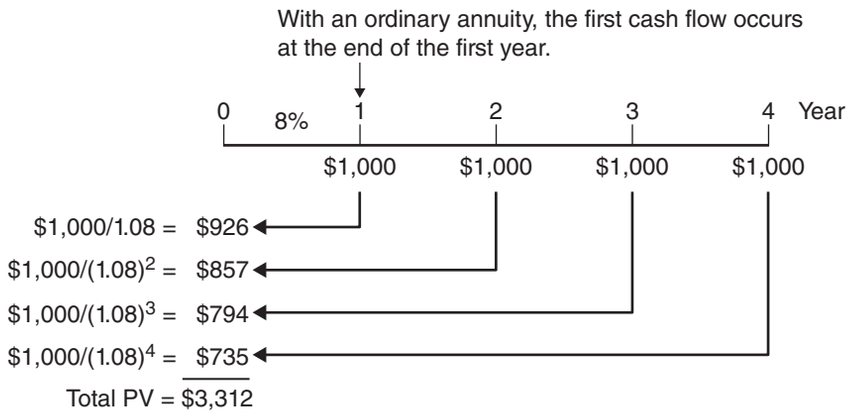
For preferred stock, PVP is the value of a share of stock, which is $50 per share. The discount rate is 6 percent. CF is the fixed-rate cash dividend, which is the unknown value. Using this information, we can use Equation 6.3 and solve for CF.

Solution

$$\text{PVP} = \frac{\text{CF}}{i}$$
$$\text{CF} = \text{PVP} \times i$$
$$= \$50 \times 0.06$$
$$= \$3$$

The annual dividend on the preferred stock would be $3 per share.

A. Ordinary Annuity



B. Annuity Due

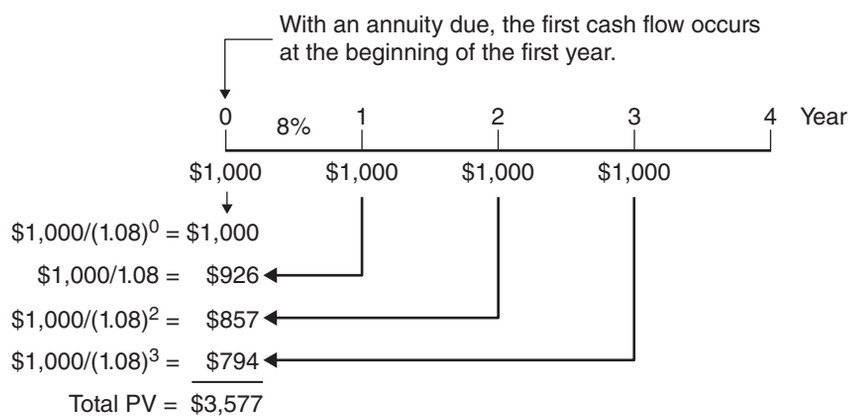


EXHIBIT 6.6 **Ordinary Annuity versus Annuity Due**

The difference between an ordinary annuity (part A) and an annuity due (part B) is that with an ordinary annuity, the cash flows take place at the end of each period, while with an annuity due, the cash flows take place at the beginning of each period. As you can see in this example, the PV of the annuity due is larger than the PV of the ordinary annuity. The reason is that the cash flows of the annuity due are shifted forward one year and thus are discounted less.

$$\text{Annuity due value} = \text{Ordinary annuity value} \times (1 + i) \tag{6.4}$$

Figure 6.36

$$\begin{aligned}\text{Annuity due value} &= \text{Ordinary annuity value} \times (1 + i)\\ &= \$3{,}312 \times 1.08\\ &= \$3{,}577\end{aligned}$$

$$\text{PVA}_n = \frac{\text{CF}_1}{i - g} \times \left[1 - \left(\frac{1 + g}{1 + i}\right)^n\right] \tag{6.5}$$

Figure 6.37

$$\begin{aligned}\text{PVA}_n &= \frac{\$307{,}500}{0.15 - 0.025} \times \left[1 - \left(\frac{1.025}{1.15}\right)^{50}\right] \\ &= \$2{,}460{,}000 \times 0.9968 \\ &= \$2{,}452{,}128\end{aligned}$$

$$\text{PVP} = \frac{\text{CF}_1}{i - g} \tag{6.6}$$

Figure 6.38

$$\begin{aligned}\text{PVP} &= \frac{\text{CF}_1}{i - g} \times \left[1 - \left(\frac{1 + g}{1 + i}\right)^{\infty}\right] \\ &= \frac{\text{CF}_1}{i - g} \times [1 - 0] \\ &= \frac{\text{CF}_1}{i - g}\end{aligned}$$

Figure 6.39

$$CF_1 = CF_0 \times (1 + g)$$

Figure 6.40

$$PVP = \frac{CF_1}{i - g} = \frac{CF_0 \times (1 + g)}{i - g}$$

Figure 6.41

$$\begin{aligned} PVP &= \frac{CF_0 \times (1 + g)}{i - g} \\ &= \frac{\$450{,}000 \times (1 + 0.05)}{0.18 - 0.05} \\ &= \$3{,}634{,}615 \end{aligned}$$

$$EAR = \left[1 + \frac{\text{Quoted interest rate}}{m}\right]^m - 1 \qquad (6.7)$$

Figure 6.42

$$\begin{aligned} EAR &= \left(1 + \frac{\text{Quoted interest rate}}{m}\right)^m - 1 \\ &= \left(1 + \frac{0.12}{12}\right)^{12} - 1 \\ &= (1.01)^{12} - 1 \\ &= 1.1268 - 1 \\ &= 0.1268, \text{ or } 12.68\% \end{aligned}$$

Figure 6.43

$$\text{Lender A: EAR} = \left(1 + \frac{0.1040}{12}\right)^{12} - 1$$
$$= (1.0087)^{12} - 1$$
$$= 1.1091 - 1$$
$$= 0.1091, \text{ or } 10.91\%$$
$$\text{Lender B: EAR} = \left(1 + \frac{0.1090}{1}\right)^{1} - 1$$
$$= 1.1090 - 1$$
$$= 0.1090, \text{ or } 10.90\%$$
$$\text{Lender C: EAR} = \left(1 + \frac{0.1050}{4}\right)^{4} - 1$$
$$= (1.0263)^{4} - 1$$
$$= 1.1092 - 1$$
$$= 0.1092, \text{ or } 10.92\%$$

LEARNING BY DOING

APPLICATION 6.8 | What Is the True Cost of a Loan?

Problem During a period of economic expansion, Frank Smith became financially overextended and was forced to consolidate his debt with a loan from a consumer finance company. The consolidated debt provided Frank with a single loan and lower monthly payments than he had previously been making. The loan agreement quotes an APR of 20 percent, and Frank must make monthly payments. What is the true cost of the loan?

Approach The true cost of the loan is the EAR, not the APR. Thus, we must convert the quoted rate into the EAR, using Equation 6.7, to get the true cost of the loan.

Solution

$$\text{EAR} = \left(1 + \frac{\text{Quoted interest rate}}{m}\right)^{m} - 1$$
$$= \left(1 + \frac{0.20}{12}\right)^{12} - 1$$
$$= (1 + 0.0167)^{12} - 1$$
$$= (1.0167)^{12} - 1$$
$$= 1.2194 - 1$$
$$= 0.2194, \text{ or } 21.94\%$$

The true cost of the loan is 21.94 percent, not the 20 percent APR.

Figure 6.44

$$\begin{aligned}\text{EAR} &= \left(1 + \frac{\text{APR}}{m}\right)^m - 1 \\ &= \left(1 + \frac{0.20}{4}\right)^4 - 1 \\ &= (1 + 0.05)^4 - 1 \\ &= 1.21551 - 1 \\ &= 0.21551, \text{ or } 21.551\%\end{aligned}$$

Figure 6.45

$$\begin{aligned}\text{FV}_2 &= \text{PV} \times (1 + i)^n \\ &= \$100 \times (1 + 0.21551)^2 \\ &= \$100 \times 1.4775 \\ &= \$147.75\end{aligned}$$

Figure 6.46

$$\begin{aligned}\text{FV}_2 &= \$100 \times (1 + 0.050)^8 \\ &= \$100 \times 1.4775 \\ &= \$147.75\end{aligned}$$

Summary of Key Equations

Equation	Description	Formula
6.1	Present value of an ordinary annuity	$\text{PVA}_n = \frac{\text{CF}}{i} \times \left[1 - \frac{1}{(1+i)^n}\right] = \text{CF} \times \left[\frac{1 - 1/(1+i)^n}{i}\right] = \text{CF} \times \frac{1 - \text{Present value factor}}{i} = \text{CF} \times \text{PV annuity factor}$
6.2	Future value of an ordinary annuity	$\text{FVA}_n = \frac{\text{CF}}{i} \times [(1+i)^n - 1] = \text{CF} \times \left[\frac{(1+i)^n - 1}{i}\right] = \text{CF} \times \frac{\text{Future value factor} - 1}{i} = \text{CF} \times \text{FV annuity factor}$
6.3	Present value of a perpetuity	$\text{PVP} = \frac{\text{CF}}{i}$
6.4	Value of an annuity due	$\text{Annuity due value} = \text{Ordinary annuity value} \times (1+i)$
6.5	Present value of a growing annuity	$\text{PVA}_n = \frac{\text{CF}_1}{i-g} \times \left[1 - \left(\frac{1+g}{1+i}\right)^n\right]$
6.6	Present value of a growing perpetuity	$\text{PVP} = \frac{\text{CF}_1}{i-g}$
6.7	Effective annual interest rate	$\text{EAR} = \left(1 + \frac{\text{Quoted interest rate}}{m}\right)^m - 1$

Self-Study Problems

6.1 Kronka, Inc., is expecting cash inflows of $13,000, $11,500, $12,750, and $9,635 over the next four years. What is the present value of these cash flows if the appropriate discount rate is 8 percent?

6.2 Your grandfather has agreed to deposit a certain amount of money each year into an account paying 7.25 percent annually to help you go to graduate school. Starting next year, and for the following four years, he plans to deposit $2,250, $8,150, $7,675, $6,125, and $12,345 into the account. How much will you have at the end of the five years?

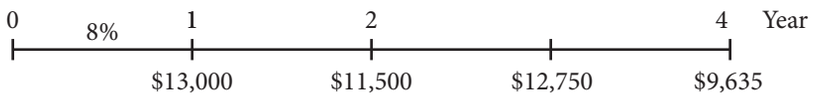
6.3 Mike White is planning to save up for a trip to Europe in three years. He will need $7,500 when he is ready to make the trip. He plans to invest the same amount at the end of each of the next three years in an account paying 6 percent. What is the amount that he will have to save every year to reach his goal of $7,500 in three years?

6.4 Becky Scholes has $150,000 to invest. She wants to be able to withdraw $12,500 every year forever without using up any of her principal. What interest rate would her investment have to earn in order for her to be able to do so?

6.5 Dynamo Corp. is expecting annual payments of $34,225 for the next seven years from a customer. What is the present value of this annuity if the discount rate is 8.5 percent?

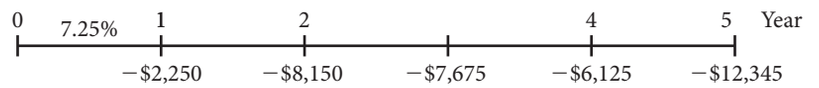
Solutions to Self-Study Problems

6.1 The time line for Kronka's cash flows and their present value is as follows:



$$PV_4 = \frac{\$13{,}000}{1.08} + \frac{\$11{,}500}{(1.08)^2} + \frac{\$12{,}750}{(1.08)^3} + \frac{\$9{,}635}{(1.08)^4}$$
$$= \$12{,}037.03 + \$9{,}859.40 + \$10{,}121.36 + \$7{,}082.01$$
$$= \$39{,}099.80$$

6.2 The time line for your cash flows and their future value is as follows:



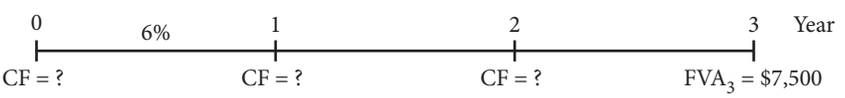
$$FV_5 = [\$2{,}250 \times (1.0725)^4] + [\$8{,}150 \times (1.0725)^3] + [\$7{,}675 \times (1.0725)^2] + [\$6{,}125 \times 1.0725] + \$12{,}345$$
$$= \$2{,}976.95 + \$10{,}054.25 + \$8{,}828.22 + \$6{,}569.06 + \$12{,}345.00$$
$$= \$40{,}773.48$$

6.3 Amount Mike White will need in three years = $FVA_3 = \$7{,}500$

Number of years = $n = 3$

Interest rate on investment = $i = 6.0\%$

Amount that Mike needs to invest every year = PMT = ?



$$FVA_n = CF \times \frac{(1+i)^n - 1}{i}$$
$$\$7{,}500 = CF \times \frac{(1+0.06)^3 - 1}{0.06}$$
$$= CF \times 3.1836$$
$$CF = \frac{\$7{,}500}{3.1836}$$
$$= \$2{,}355.82$$

Mike will have to save $2,355.82 every year for the next three years.

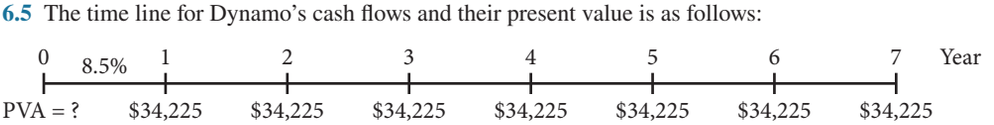
6.4 Present value of Becky Scholes's investment = $150,000

Amount needed annually = $12,500

This is a perpetuity.

$$PVP = \frac{CF}{i}$$
$$i = \frac{CF}{PVP} = \frac{\$12{,}500}{\$150{,}000}$$
$$i = 8.33\%$$

6.5 The time line for Dynamo's cash flows and their present value is as follows:



$$PVA_7 = CF \times \frac{1 - 1/(1+i)^n}{i}$$
$$= \$34{,}225 \times \frac{1 - 1/(1+0.085)^7}{0.085}$$
$$= \$34{,}225 \times 5.118514$$
$$= \$175{,}181.14$$

Discussion Questions

6.1 Identify the steps involved in computing the future value when you have multiple cash flows.

6.2 What is the key economic principle involved in calculating the present value or future value of multiple cash flows?

6.3 What is the difference between a perpetuity and an annuity?

6.4 Define *annuity due.* Would an investment be worth more if it were an ordinary annuity or an annuity due? Explain.

6.5 Raymond Bartz is trying to choose between two equally risky annuities, each paying $5,000 per year for five years. One is an ordinary annuity, and the other is an annuity due. Which of the following statements is most correct?

a. The present value of the ordinary annuity must exceed the present value of the annuity due, but the future value of an ordinary annuity may be less than the future value of the annuity due.

b. The present value of the annuity due exceeds the present value of the ordinary annuity, while the future value of the annuity due is less than the future value of the ordinary annuity.

c. The present value of the annuity due exceeds the present value of the ordinary annuity, and the future value of the annuity due also exceeds the future value of the ordinary annuity.

d. If interest rates increase, the difference between the present value of the ordinary annuity and the present value of the annuity due remains the same.

6.6 Which of the following investments will have the highest future value at the end of three years? Assume that the effective annual rate for all investments is the same.

a. You earn $3,000 at the end of three years (a total of one payment).

b. You earn $1,000 at the end of every year for the next three years (a total of three payments).

c. You earn $1,000 at the beginning of every year for the next three years (a total of three payments).

6.7 Explain whether or not each of the following statements is correct.

a. A 15-year mortgage will have larger monthly payments than a 30-year mortgage of the same amount and same interest rate.

b. If an investment pays 10 percent interest compounded annually, its effective annual rate will also be 10 percent.

6.8 When will the annual percentage rate (APR) be the same as the effective annual rate (EAR)?

6.9 Why is the effective annual rate (EAR) superior to the annual percentage rate (APR) in measuring the true economic cost or return?

6.10 Suppose three investments have equal lives and multiple cash flows. A high discount rate tends to favor:

a. The investment with large cash flows early.

b. The investment with large cash flows late.

c. The investment with even cash flows.

d. None of the investments since they have equal lives.

Questions and Problems

Basic

6.1 Future value with multiple cash flows: Konerko, Inc., management expects the company to earn cash flows of $13,227, $15,611, $18,970, and $19,114 over the next four years. If the company uses an 8 percent discount rate, what is the future value of these cash flows at the end of Year 4?

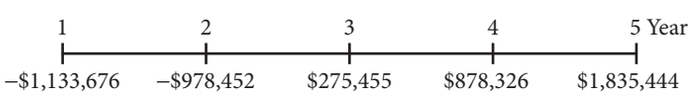
6.2 Future value with multiple cash flows: Ben Woolmer has an investment that will pay him the following cash flows over the next five years: $2,350, $2,725, $3,128, $3,366, and $3,695. If his investments typically earn 7.65 percent, what is the future value of the investment's cash flows at the end of five years?

6.3 Future value with multiple cash flows: You are a freshman in college and are planning a trip to Europe when you graduate from college at the end of four years. You plan to save the following amounts annually, starting today: $625, $700, $700, and $750. If you can earn 5.75 percent annually, how much will you have at the end of four years?

6.4 Present value with multiple cash flows: Saul Cervantes has just purchased some equipment for his landscaping business. For this equipment he must pay the following amounts at the end of each of the next five years: $10,450, $8,500, $9,675, $12,500, and $11,635. If the appropriate discount rate is 10.875 percent, what is the cost in today's dollars of the equipment Saul purchased today?

6.5 Present value with multiple cash flows: Jeremy Fenloch borrowed some money from his friend and promised to repay him $1,225, $1,350, $1,500, $1,600, and $1,600 over the next five years. If the friend normally discounts investment cash flows at 8 percent annually, how much did Jeremy borrow?

6.6 Present value with multiple cash flows: Biogenesis Inc. management expects the following cash flow stream over the next five years. They discount all cash flows using a 23 percent discount rate. What is the present value of this cash flow stream?



6.7 Present value of an ordinary annuity: An investment opportunity requires a payment of $750 for 12 years, starting a year from today. If your required rate of return is 8 percent, what is the value of the investment to you today?

6.8 Present value of an ordinary annuity: Dynamics Telecommunications Corp. has made an investment in another company that will guarantee it a cash flow of $22,500 each year for the next five years. If the company uses a discount rate of 15 percent on its investments, what is the present value of this investment?

6.9 Future value of an ordinary annuity: Robert Hobbes plans to invest $25,000 a year at the end of each year for the next seven years in an investment that will pay him a rate of return of 11.4 percent. How much money will Robert have at the end of seven years?

6.10 Future value of an ordinary annuity: Cecelia Thomas is a sales executive at a Baltimore firm. She is 25 years old and plans to invest $3,000 every year in an IRA account, beginning at the end of this year until she reaches age 65. If the IRA investment will earn 9.75 percent annually, how much will she have in 40 years, when she turns 65?

6.11 Future value of an annuity due: Refer to Problem 6.10. If Cecelia invests at the beginning of each year, how much will she have at age 65?

6.12 Computing annuity payment: Kevin Winthrop is saving for an Australian vacation in three years. He estimates that he will need $5,000 to cover his airfare and all other expenses for a week-long holiday in Australia. If he can invest his money in an S&P 500 equity index fund that is expected to earn an average annual return of 10.3 percent over the next three years, how much will he have to save every year if he starts saving at the end of this year?

6.13 Computing annuity payment: The Elkridge Bar & Grill has a seven-year loan of $23,500 with Bank of America. It plans to repay the loan in seven equal installments starting today. If the rate of interest is 8.4 percent, how much will each payment be?

6.14 Perpetuity: Your grandfather is retiring at the end of next year. He would like to ensure that his heirs receive payments of $10,000 a year forever, starting when he retires. If he can earn 6.5 percent annually, how much does your grandfather need to invest to produce the desired cash flow?

6.15 Perpetuity: Calculate the annual cash flows for each of the following investments:

a. $250,000 invested at 6 percent.

b. $50,000 invested at 12 percent.

c. $100,000 invested at 10 percent.

6.16 Effective annual interest rate: Marshall Chavez bought a Honda Civic for $17,345. He put down $6,000 and financed the rest through the dealer at an APR of 4.9 percent for four years. What is the effective annual interest rate (EAR) if the loan payments are made monthly?

6.17 Effective annual interest rate: Cyclone Rentals borrowed $15,550 from a bank for three years. If the quoted rate (APR) is 6.75 percent, and the compounding is daily, what is the effective annual interest rate (EAR)?

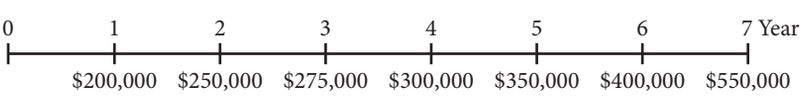
6.18 Growing perpetuity: You are evaluating a growing perpetuity investment from a large financial services firm. The investment promises an initial payment of $20,000 at the end of this year and subsequent payments that will grow at a rate of 3.4 percent annually. If you use a 9 percent discount rate for investments like this, what is the present value of this growing perpetuity?

Intermediate

6.19 Future value with multiple cash flows: Trigen Corp. management will invest $331,000, $616,450, $212,775, $818,400, $1,239,644, and $1,617,848 in research and development over the next six years. If the appropriate interest rate is 6.75 percent, what is the future value of these investments eight years from today?

6.20 Future value with multiple cash flows: Stephanie Watson is 20 years old and plans to make the following investments beginning next year. She will invest $3,125 in each of the next three years and will then make investments of $3,650, $3,725, $3,875, and $4,000 over the following four years. If the investments are expected to earn 11.5 percent annually, how much will Stephanie have when she turns 30?

6.21 Present value with multiple cash flows: Carol Jenkins, a lottery winner, will receive the following payments over the next seven years. She has been approached by an investor who will pay Carol a lump sum today for the rights to those future cash flows. If she can invest her cash flows in a fund that will earn 10.5 percent annually, how much should Carol require the investor to pay for the cash flows?



6.22 Computing annuity payment: Gary Whitmore is a high school sophomore. He currently has $7,500 in a savings account that pays 5.65 percent annually. Gary plans to use his current savings plus what he can save over the next four years to buy a car. He estimates that the car will cost $12,000 in four years. How much money should Gary save each year if he wants to buy the car?

6.23 Growing annuity: Modern Energy Company owns several gas stations. Management is looking to open a new station in the western suburbs of Baltimore. One possibility that managers at the company are evaluating is to take over a station located at a site that has been leased from the county. The lease, originally for 99 years, currently has 73 years before expiration. The gas station generated a net cash flow of $92,500 last year, and the current owners expect an annual growth rate of 6.3 percent. If Modern Energy uses a discount rate of 14.5 percent to evaluate such businesses, what is the present value of this growing annuity?

6.24 Future value of annuity due: Jeremy Denham plans to save $5,000 every year for the next eight years, starting today. At the end of eight years, Jeremy will turn 30 years old and plans to use his savings toward the down payment on a house. If his investment in a mutual fund will earn him 10.3 percent annually, how much will he have saved in eight years when he buys his house?

6.25 Present value of an annuity due: Grant Productions borrowed some money from the California Finance Company at a rate of 17.5 percent for a seven-year period. The loan calls for a payment of $1,540,862.19 each year beginning today. How much did Grant borrow?

6.26 Present value of an annuity due: Sharon Kabana has won a state lottery and will receive a payment of $89,729.45 every year, starting today, for the next 20 years. If she invests the proceeds at a rate of 7.25 percent, what is the present value of the cash flows that she will receive? Round to the nearest dollar.

6.27 Present value of an annuity due: You wrote a piece of software that does a better job of allowing computers to network than any other program designed for this purpose. A large networking company wants to incorporate your software into its systems and is offering to pay you $500,000 today, plus $500,000 at the end of each of the following six years, for permission to do this. If the appropriate interest rate is 6 percent, what is the present value of the cash flow stream that the company is offering you?

6.28 Present value of an annuity: Suppose that the networking company in Problem 6.27 will not start paying you until the first of the new systems that uses your software is sold in two years. What is the present value of that annuity? Assume that the appropriate interest rate is still 6 percent.

6.29 Perpetuity: Calculate the present value of the following perpetuities:

- **a.** $1,250 discounted to the present at 7 percent.
- **b.** $7,250 discounted to the present at 6.33 percent.
- **c.** $850 discounted to the present at 20 percent.

6.30 Effective annual interest rate: Find the effective annual interest rate (EAR) for each of the following:

- **a.** 6 percent compounded quarterly.
- **b.** 4.99 percent compounded monthly.
- **c.** 7.25 percent compounded semiannually.
- **d.** 5.6 percent compounded daily.

6.31 Effective annual interest rate: Which of the following investments has the highest effective annual interest rate (EAR)?

- **a.** A bank CD that pays 8.25 percent compounded quarterly.
- **b.** A bank CD that pays 8.25 percent compounded monthly.
- **c.** A bank CD that pays 8.45 percent compounded annually.
- **d.** A bank CD that pays 8.25 percent compounded semiannually.
- **e.** A bank CD that pays 8 percent compounded daily (on a 365-day per year basis).

6.32 Effective annual interest rate: You are considering three alternative investments: (1) a three-year bank CD paying 7.5 percent compounded quarterly; (2) a three-year bank CD paying 7.3 percent compounded monthly; and (3) a three-year bank CD paying 7.75 percent compounded annually. Which investment has the highest effective annual interest rate (EAR)?

Advanced

6.33 You have been offered the opportunity to invest in a project that is expected to provide you with the following cash flows: $4,000 in one year, $12,000 in two years, and $8,000 in three years. If the appropriate interest rates are 6 percent for the first year, 8 percent for the second year, and 12 percent for the third year, what is the present value of these cash flows?

6.34 Tirade Owens, a professional athlete, currently has a contract that will pay him a large amount in the first year of his contract and smaller amounts thereafter. He and his agent have asked the team to restructure the contract. The team, though reluctant, obliged. Tirade and his agent came up with a counteroffer. What are the present values of each of the three alternatives below using a 14 percent discount rate? Which of the three has the highest present value?

Year	Current Contract	Team's Offer	Counteroffer
1	$8,125,000	$4,000,000	$5,250,000
2	$3,650,000	$3,825,000	$7,550,000
3	$2,715,000	$3,850,000	$3,625,000
4	$1,822,250	$3,925,000	$2,800,000

6.35 Gary Kornig is 30 years old and wants to retire when he is 65. So far he has saved (1) $6,950 in an IRA account in which his money is earning 8.3 percent annually and (2) $5,000 in a money market account in which he is earning 5.25 percent annually. Gary wants to have $1 million when he retires. Starting next year, he plans to invest the same amount of money every year until he retires in a mutual fund in which he expects to earn 9 percent annually. How much will Gary have to invest every year to achieve his savings goal?

6.36 The top prize for the state lottery is $100,000,000. You have decided it is time for you to take a chance and purchase a ticket. Before you purchase the ticket, you must decide whether to choose the cash option or the annual payment option. If you choose the annual payment option and win, you will receive $100,000,000 in 25 equal payments of $4,000,000—one payment today and one payment at the end of each of the next 24 years. If you choose the cash payment, you will receive a one-time lump sum payment of $59,194,567.18. If you can invest the proceeds and earn 6 percent, which option should you choose?

6.37 At what interest rate would you be indifferent between the cash and annual payment options in Problem 6.36?

6.38 Babu Baradwaj is saving for his son's college tuition. His son is currently 11 years old and will begin college in seven years. Babu has an index fund investment worth $7,500 that is earning 9.5 percent annually. Total expenses at the University of Maryland, where his son says he plans to go, currently total $15,000 per year but are expected to grow at roughly 6 percent each year. Babu plans to invest in a mutual fund that will earn 11 percent annually to make up the difference between the college expenses and his current savings. In total, Babu will make seven equal investments with the first starting today and the last being made a year before his son begins college.

a. What will be the present value of the four years of college expenses at the time that Babu's son starts college? Assume a discount rate of 5.5 percent.

b. What will the value of the index mutual fund be when his son just starts college?

c. What is the amount that Babu will have to have saved when his son turns 18 if Babu plans to cover all of his son's college expenses?

d. How much will Babu have to invest every year in order to have enough funds to cover all his son's expenses?

6.39 You are now 50 years old and plan to retire at age 65. You currently have a stock portfolio worth $150,000, a 401(k) retirement plan worth $250,000, and a money market account worth $50,000. Your stock portfolio is expected to provide annual returns of 12 percent, your 401(k) investment will earn 9.5 percent annually, and the money market account earns 5.25 percent, compounded monthly.

a. If you do not save another penny, what will be the total value of your investments when you retire at age 65?

b. Assume you plan to invest $12,000 every year in your 401(k) plan for the next 15 years (starting one year from now). How much will your investments be worth when you retire at age 65?

c. Assume that you expect to live 25 years after you retire (until age 90). Today, at age 50, you take all of your investments and place them in an account that pays 8 percent (use the scenario from part b in which you continue saving). If you start withdrawing funds starting at age 66, how much can you withdraw every year (e.g., an ordinary annuity) and leave nothing in your account after a 25th and final withdrawal at age 90?

d. You want your current investments, which are described in the problem statement, to support a perpetuity that starts a year from now. How much can you withdraw each year without touching your principal?

6.40 Trevor Diaz wants to purchase a Maserati Quattroporte sedan, which has an invoice price of $121,737 and a total cost of $129,482. Trevor plans to put down $20,000 and will pay the rest by taking on a 5.75 percent five-year bank loan. What is the monthly payment on this auto loan? Prepare an amortization table using Excel.

6.41 The Yan family is buying a new 3,500-square-foot house in Muncie, Indiana, and will borrow $237,000 from Bank One at a rate of 6.375 percent for 15 years. What will be their monthly loan payment? Prepare an amortization schedule using Excel.

6.42 Assume you will start working as soon as you graduate from college. You plan to start saving for your retirement on your 25th birthday and retire on your 65th birthday. After retirement, you expect to live at least until you are 85. You wish to be able to withdraw $40,000 (in today's dollars) every year from the time of your retirement until you are 85 years old (i.e., for 20 years). The average inflation rate is likely to be 5 percent.

a. Calculate the lump sum you need to have accumulated at age 65 to be able to draw the desired income. Assume that the annual return on your investments is likely to be 10 percent.

b. What is the dollar amount you need to invest every year, starting at age 26 and ending at age 65 (i.e., for 40 years), to reach the target lump sum at age 65?

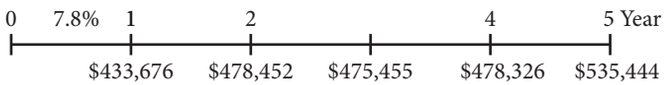
c. Now answer questions **a.** and **b.** assuming the rate of return to be 8 percent per year, then again at 15 percent per year.

d. Now assume you start investing for your retirement when you turn 30 years old and analyze the situation under rate of return assumptions of (i) 8 percent, (ii) 10 percent, and (iii) 15 percent.

e. Repeat the analysis by assuming that you start investing when you are 35 years old.

Sample Test Problems

6.1 Freisinger, Inc., management is expecting a new project to start paying off, beginning at the end of next year. Cash flows are expected to be as follows:



If Freisinger can reinvest these cash flows to earn a return of 7.8 percent, what is the future value of this cash flow stream at the end of five years? What is its present value?

6.2 Compare an annuity due with an ordinary annuity. The payments for both are made annually and are of the same dollar amounts. The two annuities also have the same duration in years and the same discount rate. Which of the following statements is/are correct?

a. The present value of the ordinary annuity is greater.

b. The present value of the annuity due is greater.

c. The future value of the ordinary annuity is greater.

d. The future value of the annuity due is greater.

6.3 You plan to set up an endowment at your alma mater that will fund $200,000 of scholarships each year indefinitely. If the principal (the amount you donate) can be invested at 5.5 percent, compounded annually, how much do you need to donate to the university today, so that the first scholarships can be awarded beginning one year from now?

6.4 Annalise Genric wants to open a restaurant in a historic building. The property can be leased for 20 years but not purchased. She believes her restaurant can generate a net cash flow of $76,000 the first year and expects an annual growth rate of 4 percent thereafter. If a discount rate of 15 percent is used to evaluate this business, what is the present value of the cash flows that it will generate?

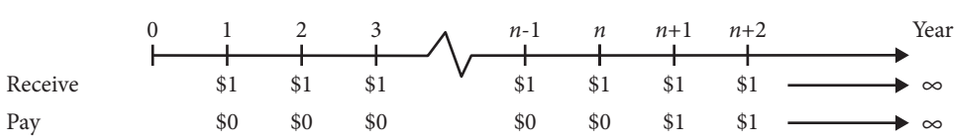
6.5 A credit card offers financing at an APR of 18 percent, with monthly compounding on outstanding charges. What is the effective annual rate (EAR)?

6.6 Thomas Nguyen currently has $10,000 in the bank earning interest of 6 percent per year, compounded monthly. If he needs $25,000 to purchase a car and can save an additional $100 a month stating at the end of this month, how long will it take him to accumulate the $25,000?

Appendix: Deriving the Formula for the Present Value of an Ordinary Annuity

In this chapter we showed that the formula for a perpetuity can be obtained from the formula for the present value of an ordinary annuity if n is set equal to ∞. It is also possible to go the other way. In other words, the present value of an ordinary annuity formula can be derived from the formula for a perpetuity. In fact, this is how the annuity formula was originally obtained. To see how this was done, assume that someone has offered to pay you $1 per year forever, beginning next year, but that, in return, you will have to pay that person $1 per year forever, beginning in year $n + 1$.

The cash flows you will receive and the cash flows you will pay are represented in the following time line:



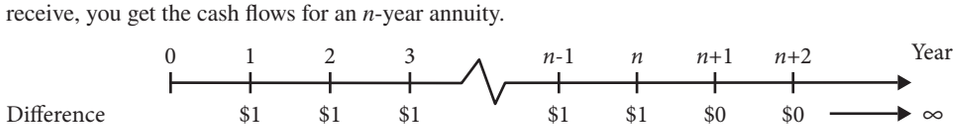
The first row of dollar values shows the cash flows for the perpetuity that you will receive. This perpetuity is worth:

$$\text{PVP}_{Receive} = \frac{\$1}{i} = \frac{\text{CF}}{i}$$

The second row shows the cash flows for the perpetuity that you will pay. The present value of what you owe is the value of a $1 perpetuity that is discounted for n years.

$$\text{PVP}_{Pay} = \frac{\$1/i}{(1+i)^n} = \frac{\text{CF}/i}{(1+i)^n}$$

Notice that if you subtract, year by year, the cash flows you would pay from the cash flows you would receive, you get the cash flows for an n-year annuity.



Therefore, the value of the offer equals the value of an n-year annuity. Solving for the difference between $PVP_{Receive}$ and PVP_{Pay} we see that this is the same as Equation 6.1.

$$\begin{aligned} PVA_n &= PVP_{Receive} - PVP_{Pay} \\ &= \frac{CF}{i} - \frac{CF/i}{(1+i)^n} \\ &= \frac{CF}{i} \times \left[1 - \frac{1}{(1+i)^n}\right] \end{aligned}$$

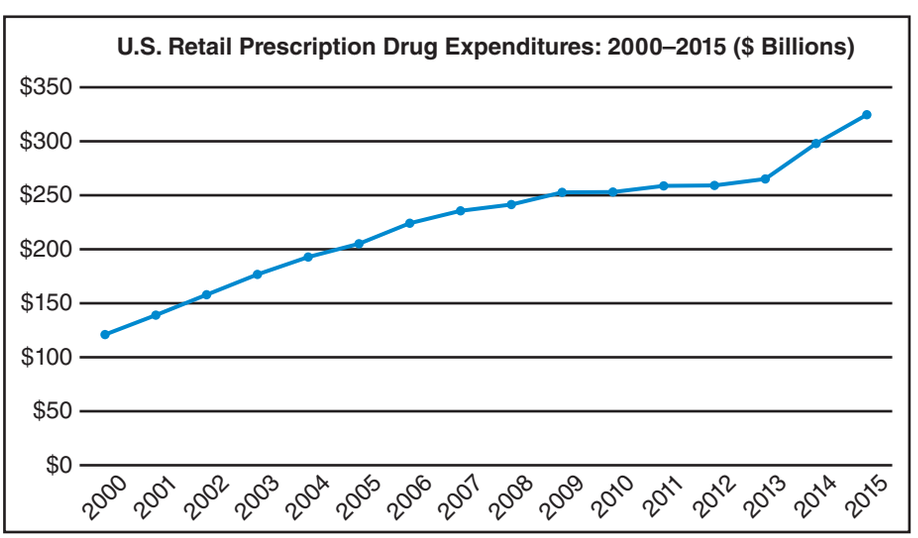


Figure 7.1

Stock	Expected Return (%)	Risk Level (%)
A	12	12
B	12	16
C	16	16

Figure 7.2

$$R_{CA} = \frac{\text{Capital appreciation}}{\text{Initial price}} = \frac{P_1 - P_0}{P_0} = \frac{\Delta P}{P_0}$$

Figure 7.3

$$R_I = \frac{\text{Cash flow}}{\text{Initial price}} = \frac{CF_1}{P_0}$$

LEARNING BY DOING

APPLICATION 7.1 | Calculating the Return on an Investment

Problem You purchased a beat-up 1974 Datsun 240Z sports car a year ago for $1,500. Datsun is what Nissan, the Japanese car company, was called in the 1970s. The 240Z was the first in a series of cars that led to the Nissan 370Z that is being sold today. Recognizing that a mint-condition 240Z is a much sought-after car, you invested $7,000 and a lot of your time fixing up the car. Last week, you sold it to a collector for $18,000. Not counting the value of the time you spent restoring the car, what is the total return you earned on this investment over the one-year holding period?

Approach Use Equation 7.1 to calculate the total holding period return. To calculate R_T using Equation 7.1, you must know P_0, P_1, and CF_1. In this problem, you can assume that the $7,000 was spent at the time you bought the car to purchase parts and materials. Therefore, your initial investment, P_0, was $1,500 + $7,000 = $8,500. Since there were no other cash inflows or outflows between the time that you bought the car and the time that you sold it, CF_1 equals $0.

Solution The total holding period return is:

$$R_T = R_{CA} + R_I = \frac{P_1 - P_0 + CF_1}{P_0} = \frac{\$18{,}000 - \$8{,}500 + \$0}{\$8{,}500} = 1.118, \text{ or } 111.8\%$$

$$R_T = R_{CA} + R_I = \frac{\Delta P}{P_0} + \frac{CF_1}{P_0} = \frac{\Delta P + CF_1}{P_0} \tag{7.1}$$

Figure 7.4

$$\begin{aligned} R_T = R_{CA} + R_I &= \frac{P_1 - P_0 + CF_1}{P_0} \\ &= \frac{\$19.00 - \$16.06 + \$0.00}{\$16.06} \\ &= 0.183, \text{ or } 18.3\% \end{aligned}$$

Figure 7.5

$$R_T = R_{CA} + R_I = \frac{P_1 - P_0 + CF_1}{P_0} = \frac{\$18.00 - \$16.06 + \$1.00}{\$16.06} = 0.183, \text{ or } 18.3\%$$

Figure 7.6

$$E(\text{Bonus}) = (p_H \times B_H) + (p_{NH} \times B_{NH})$$

Figure 7.7

$$\begin{aligned}\text{E(Bonus)} &= (p_{\text{H}} \times \text{B}_{\text{H}}) + (p_{\text{NH}} \times \text{B}_{\text{NH}}) \\ &= (0.325 \times \$800{,}000) + (0.675 \times \$400{,}000) = \$530{,}000\end{aligned}$$

Figure 7.8

$$\text{E(Bonus)} = (0.5 \times \$800{,}000) + (0.5 \times \$400{,}000) = \$600{,}000$$

$$\text{E}(\text{R}_{\text{Asset}}) = \sum_{i=1}^{n} (p_i \times \text{R}_i) = (p_1 \times \text{R}_1) + (p_2 \times \text{R}_2) + \cdots + (p_n \times \text{R}_n) \qquad (7.2)$$

Figure 7.9

$$\text{E}(\text{R}_{\text{Asset}}) = \frac{\sum_{i=1}^{n} (\text{R}_i)}{n} = \frac{\text{R}_1 + \text{R}_2 + \cdots + \text{R}_n}{n}$$

Figure 7.10

$$\text{R}_{\text{T}} = \text{R}_{\text{CA}} = \frac{\text{P}_1 - \text{P}_0}{\text{P}_0}$$

Figure 7.11

Twitter Stock Price in One Year	Total Return
$18.50	$\frac{\$18.50 - \$19.00}{\$19.00} = -0.0263$, or -2.63%
$20.50	$\frac{\$20.50 - \$19.00}{\$19.00} = 0.0789$, or 7.89%
$21.00	$\frac{\$21.00 - \$19.00}{\$19.00} = 0.1053$, or 10.53%
$22.00	$\frac{\$22.00 - \$19.00}{\$19.00} = 0.1579$, or 15.79%

Figure 7.12

$$\begin{aligned} E(R_{Twitter}) &= \sum_{i=1}^{4} (p_i \times R_i) = (p_1 \times R_1) + (p_2 \times R_2) + (p_3 \times R_3) + (p_4 \times R_4) \\ &= (0.3 \times -0.0263) + (0.3 \times 0.0789) + (0.3 \times 0.1053) + (0.1 \times 0.1579) \\ &= -0.00789 + 0.02367 + 0.03159 + 0.01579 = 0.0632, \text{ or } 6.32\% \end{aligned}$$

LEARNING BY DOING

APPLICATION 7.2 | Calculating Expected Returns

Problem You have just purchased 100 railroad cars that you plan to lease (rent) to a large railroad company. Demand for shipping goods by rail has recently increased dramatically due to the rising price of oil. You expect oil prices, which are currently at $98.81 per barrel, to reach $115.00 per barrel in the next year. If this happens, railroad shipping prices will increase, thereby driving up the value of your railroad cars as increases in demand outpace the rate at which new cars are being produced.

Given your oil price prediction, you estimate that there is a 30 percent chance that the value of your railroad cars will increase by 15 percent, a 40 percent chance that their value will increase by 25 percent, and a 30 percent chance that their value will increase by 30 percent in the next year. In addition to appreciation in the value of your cars, you expect to earn 10 percent on your investment over the next year (after expenses) from leasing the railroad cars. What total return do you expect to earn on your railroad car investment over the next year?

Approach Use Equation 7.1 first to calculate the total return that you would earn under each of the three possible outcomes. Next use these total return values, along with the associated probabilities, in Equation 7.2 to calculate the expected total return.

Solution To calculate the total returns using Equation 7.1,

$$R_T = R_{CA} + R_I = \frac{\Delta P}{P_0} + \frac{CF_1}{P_0}$$

you must recognize that $\Delta P/P_0$ is the capital appreciation under each outcome and that CF_1/P_0 equals the 10 percent that you expect to receive from leasing the rail cars. The expected returns for the three outcomes are:

Increase in Value of Rail Cars in One Year	Return from Leases	Total Return
15%	10%	$R_T = \frac{\Delta P}{P_0} + \frac{CF_1}{P_0} = 0.15 + 0.10 = 0.25$, or 25%
25%	10%	$R_T = \frac{\Delta P}{P_0} + \frac{CF_1}{P_0} = 0.25 + 0.10 = 0.35$, or 35%
30%	10%	$R_T = \frac{\Delta P}{P_0} + \frac{CF_1}{P_0} = 0.30 + 0.10 = 0.40$, or 40%

You can then use Equation 7.2 to calculate the expected return for your rail car investment:

$$\begin{aligned} E(R_{\text{Rail cars}}) &= \sum_{i=1}^{3} (\rho_i \times R_i) = (\rho_1 \times R_1) + (\rho_2 \times R_2) + (\rho_3 \times R_3) \\ &= (0.3 \times 0.25) + (0.4 \times 0.35) + (0.3 \times 0.40) \\ &= 0.335, \text{ or } 33.5\% \end{aligned}$$

Alternatively, since there is a 100 percent probability that the return from leasing the railroad cars is 10 percent, you could have simply calculated the expected increase in value of the railroad cars:

$$\begin{aligned} E\left(\frac{\Delta P}{P_0}\right) &= (0.3 \times 0.15) + (0.4 \times 0.25) + (0.3 \times 0.30) \\ &= 0.235, \text{ or } 23.5\% \end{aligned}$$

and added the 10 percent to arrive at the answer of 33.5 percent. Of course, this simpler approach only works if the return from leasing is known with certainty.

EXAMPLE 7.1 | Using Expected Values in Decision Making

DECISION MAKING

Situation You are deciding whether you should advertise your pizza business on the radio or on billboards placed on local taxicabs. For $1,000 per month, you can either buy 20 one-minute ads on the radio or place your ad on 40 taxicabs.

There is some uncertainty regarding how many new customers will visit your restaurant after hearing one of your radio ads. You estimate that there is a 30 percent chance that 35 people will visit, a 45 percent chance that 50 people will visit, and a 25 percent chance that 60 people will visit. Therefore, you expect the following number of new customers to visit your restaurant in response to each radio ad:

$$\text{E(New customers per ad}_{\text{Radio}}) = (0.30 \times 35) + (0.45 \times 50) + (0.25 \times 60) = 48$$

This means that you expect 20 one-minute ads to bring in $20 \times 48 = 960$ new customers.

Similarly, you estimate that there is a 20 percent chance you will get 20 new customers in response to an ad placed on a taxi, a 30 percent chance you will get 30 new customers, a 30 percent chance that you will get 40 new customers, and a 20 percent chance that you will get 50 new customers. Therefore, you expect the following number of new customers in response to each ad that you place on a taxi:

$$\begin{aligned}\text{E(New customers per ad}_{\text{Taxi}}) &= (0.2 \times 20) + (0.3 \times 30) + (0.3 \times 40) + (0.2 \times 50)\\ &= 35\end{aligned}$$

Placing ads on 40 taxicabs is therefore expected to bring in $40 \times 35 = 1{,}400$ new customers.

Which of these two advertising options is more attractive? Is it cost-effective?

Decision You should advertise on taxicabs. For a monthly cost of $1,000, you expect to attract 1,400 new customers with taxicab advertisements but only 960 new customers if you advertise on the radio.

The answer to the question of whether advertising on taxicabs is cost-effective depends on how much the gross profits (profits after variable costs) of your business are increased by those 1,400 customers. Monthly gross profits will have to increase by $1,000, or average 72 cents per new customer ($1,000/1,400 = $0.72) to cover the cost of the advertising campaign.

Figure 7.13

$$\begin{aligned}\text{Var(Bonus)} = \sigma^2_{\text{(Bonus)}} &= \{\, p_{\text{H}} \times [\text{B}_{\text{H}} - \text{E(Bonus)}]^2\}\\ &\quad + \{p_{\text{NH}} \times [\text{B}_{\text{NH}} - \text{E(Bonus)}]^2\}\\ &= [0.325 \times (\$800{,}000 - \$530{,}000)^2]\\ &\quad + [0.675 \times (\$400{,}000 - \$530{,}000)^2]\\ &= 35{,}100{,}000{,}000 \text{ dollars}^2\end{aligned}$$

Figure 7.14

$$\sigma_{(\text{Bonus})} = (\sigma^2_{(\text{Bonus})})^{1/2} = (35{,}100{,}000{,}000 \text{ dollars}^2)^{1/2} = \$187{,}349.94$$

$$\text{Var}(\text{R}) = \sigma^2_{\text{R}} = \sum_{i=1}^{n} \{p_i \times [\text{R}_i - \text{E}(\text{R})]^2\} \tag{7.3}$$

Figure 7.15

$$\sigma^2_{\text{R}} = \frac{\sum_{i=1}^{n} [\text{R}_i - \text{E}(\text{R})]^2}{n}$$

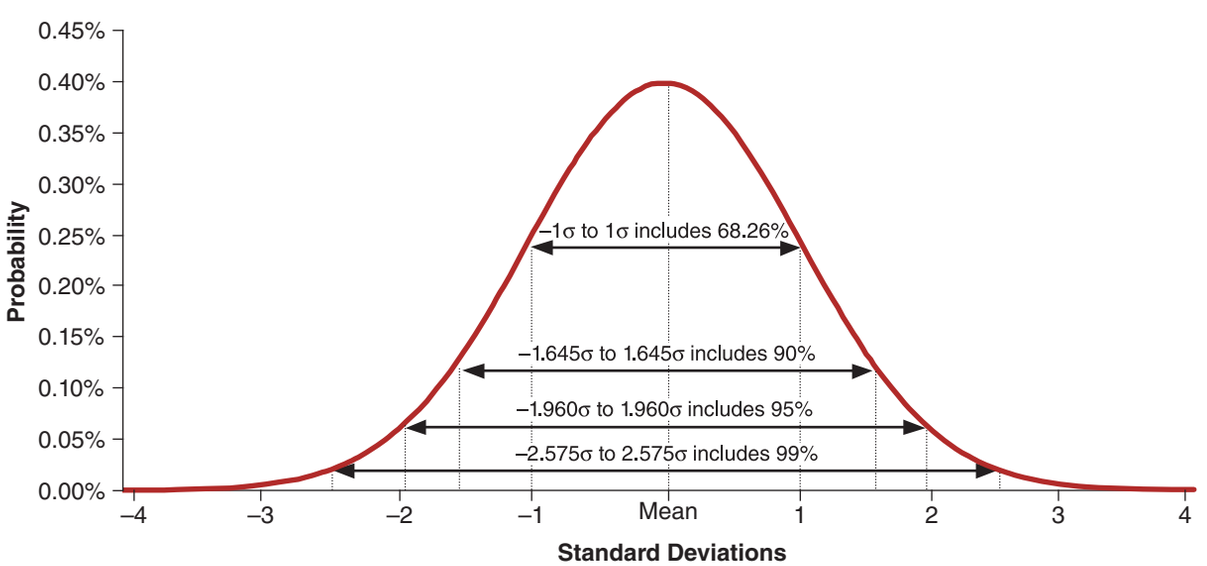


EXHIBIT 7.1 **Normal Distribution**

The normal distribution is a symmetric distribution that is completely described by its mean and standard deviation. The mean is the value that defines the center of the distribution, and the standard deviation, σ, describes the dispersion of the values centered around the mean.

Figure 7.16

Number of Standard Deviations from the Mean	Fraction of Total Observations
1.000	68.26%
1.645	90%
1.960	95%
2.575	99%

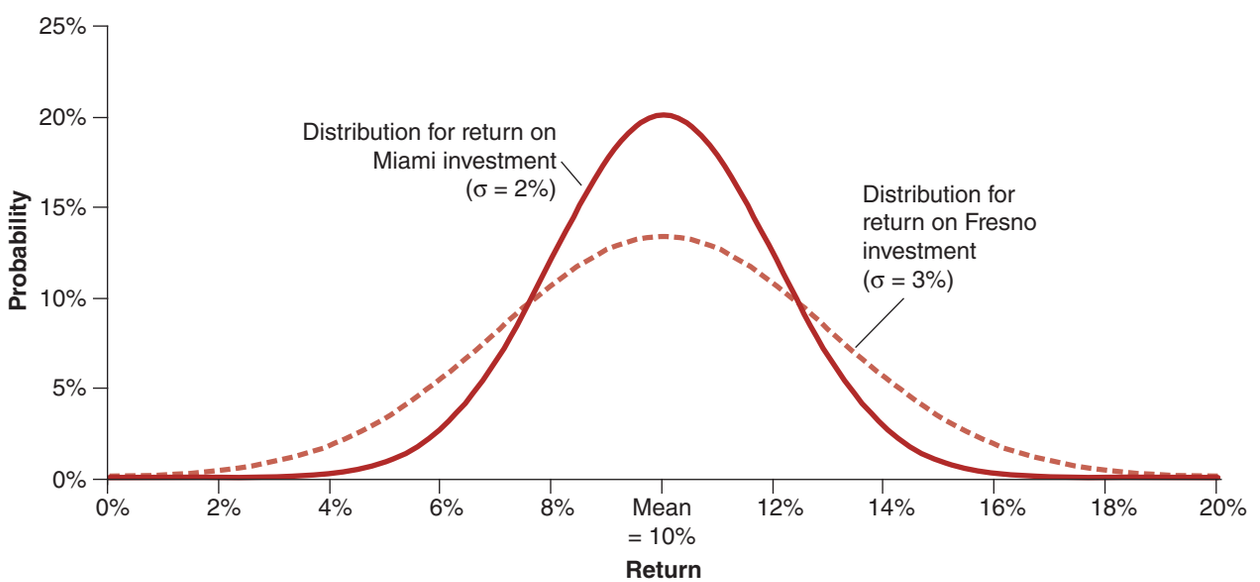


EXHIBIT 7.2 **Standard Deviation and Width of the Normal Distribution**

The larger standard deviation for the return on the Fresno investment means that the Fresno investment is riskier than the Miami investment. The actual return for the Fresno investment is more likely to be further from its expected return.

LEARNING BY DOING

APPLICATION 7.3 | Understanding the Standard Deviation

Problem You are considering investing in a share of Google Inc. stock and want to evaluate how risky this potential investment is. You know that stock returns tend to be normally distributed, and you have calculated the expected return on Google stock to be 4.67 percent and the standard deviation of the annual return to be 23 percent. Based on these statistics, within what range would you expect the return on this stock to fall during the next year? Calculate this range for a 90 percent level of confidence (that is, 90 percent of the time, the returns will fall within the specified range).

Approach Use the values in the previous table or Exhibit 7.1 to compute the range within which Google's stock return will fall 90 percent of the time. First, find the number of standard deviations associated with a 90 percent level of confidence in the table or Exhibit 7.1 and then multiply this number by the standard deviation of the annual return for Google's stock. Then subtract the resulting value from the expected return (mean) to obtain the lower end of the range and add it to the expected return to obtain the upper end.

Solution From the table, you can see that we would expect the return over the next year to be within 1.645 standard deviations of the mean 90 percent of the time. Multiplying this value by the standard deviation of Google's stock (23 percent) yields 23 percent $\times$ 1.645 = 37.835 percent. This means that there is a 90 percent chance that the return will be between -33.165 percent (4.67 percent $-$ 37.835 percent $= -33.165$ percent) and 42.505 percent (4.67 percent + 37.835 percent = 42.505 percent).

While the expected return of 4.67 percent is relatively low, the returns on Google stock vary considerably, and there is a reasonable chance that the stock return in the next year could be quite high or quite low (even negative). As you will see shortly, this wide range of possible returns is similar to the range we observe for typical shares in the U.S. stock market.

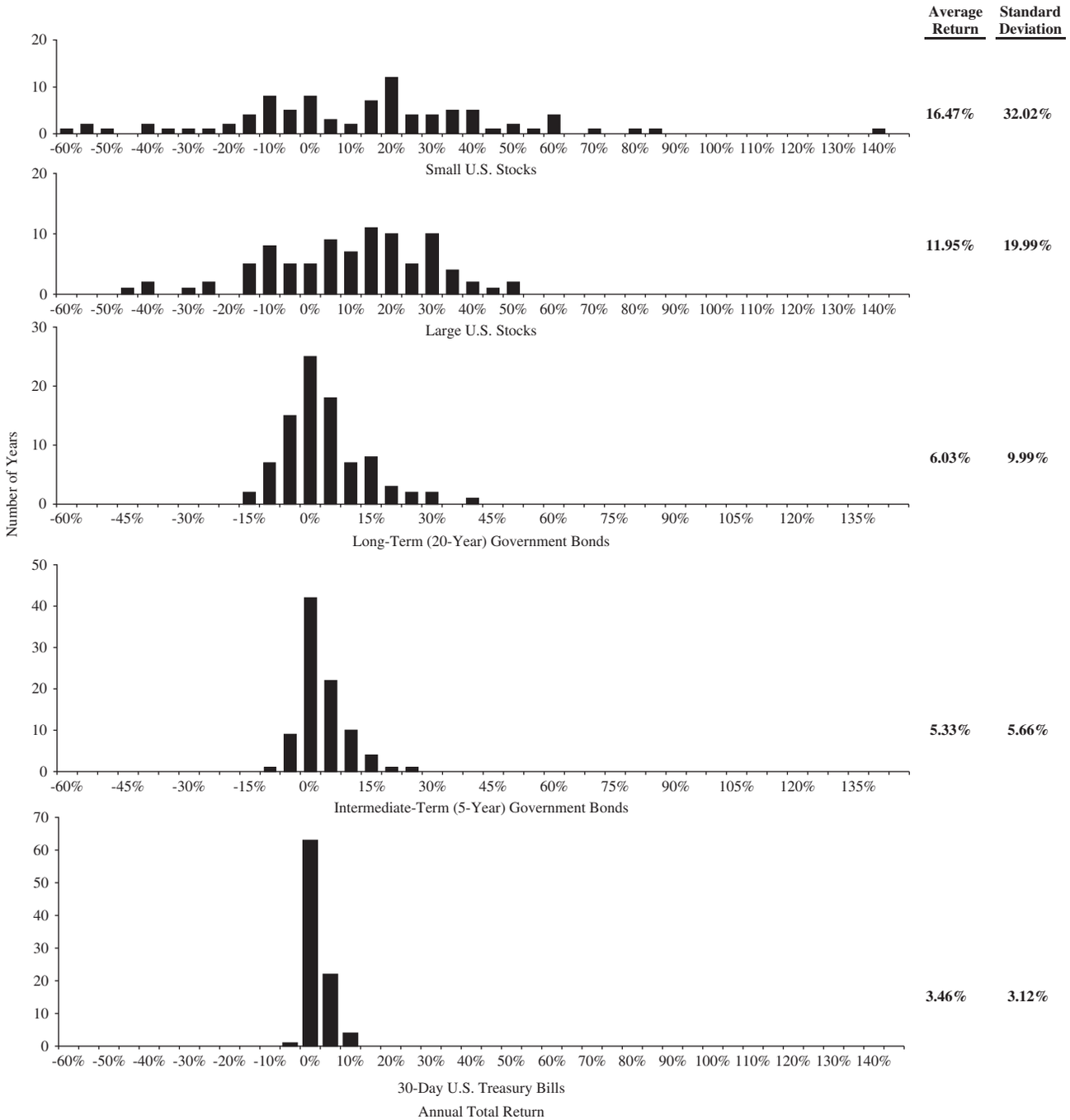


EXHIBIT 7.3 **Distributions of Annual Total Returns for U.S. Stocks and Bonds from 1926 to 2015**

Higher standard deviations of returns have historically been associated with higher returns. For example, between 1926 and 2015, the standard deviation of the annual returns for small stocks was higher than the standard deviations of the returns earned by other types of securities, and the average return that investors earned from small stocks was also higher. At the other end of the spectrum, the returns on Treasury bills had the smallest standard deviation, and Treasury bills earned the smallest average return.

Source: Data from Morningstar, 2016 SBBI Yearbook

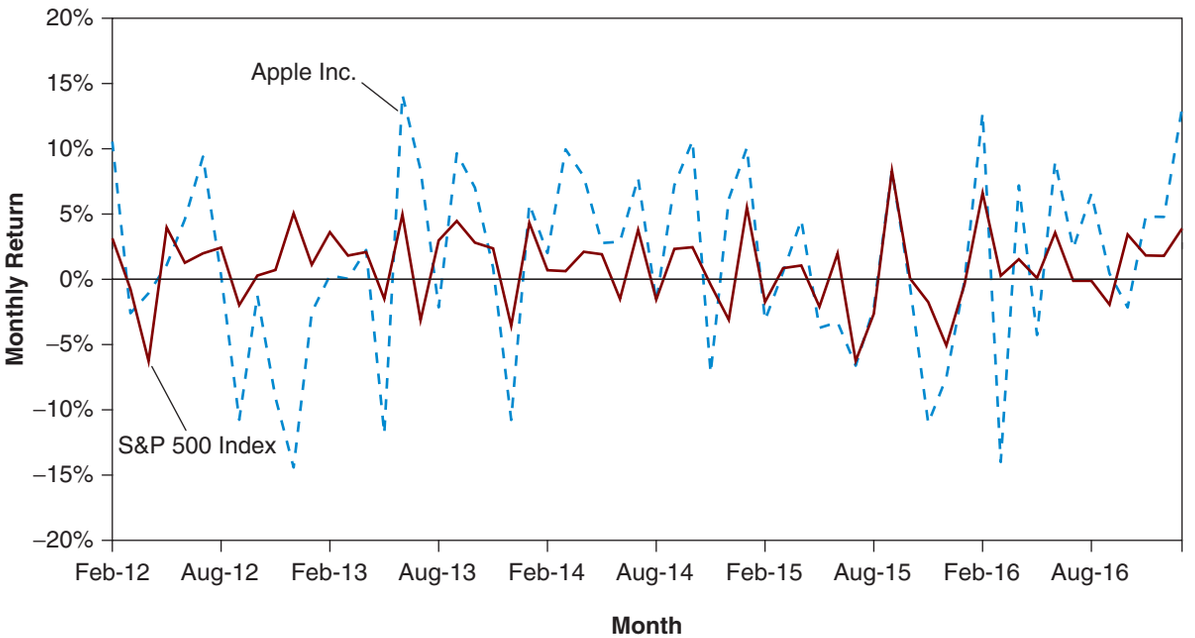


EXHIBIT 7.4 **Monthly Returns for Apple Inc. stock and the S&P 500 Index from February 2012 through January 2017**

The returns on shares of individual stocks tend to be much more volatile than the returns on portfolios of stocks, such as the S&P 500.

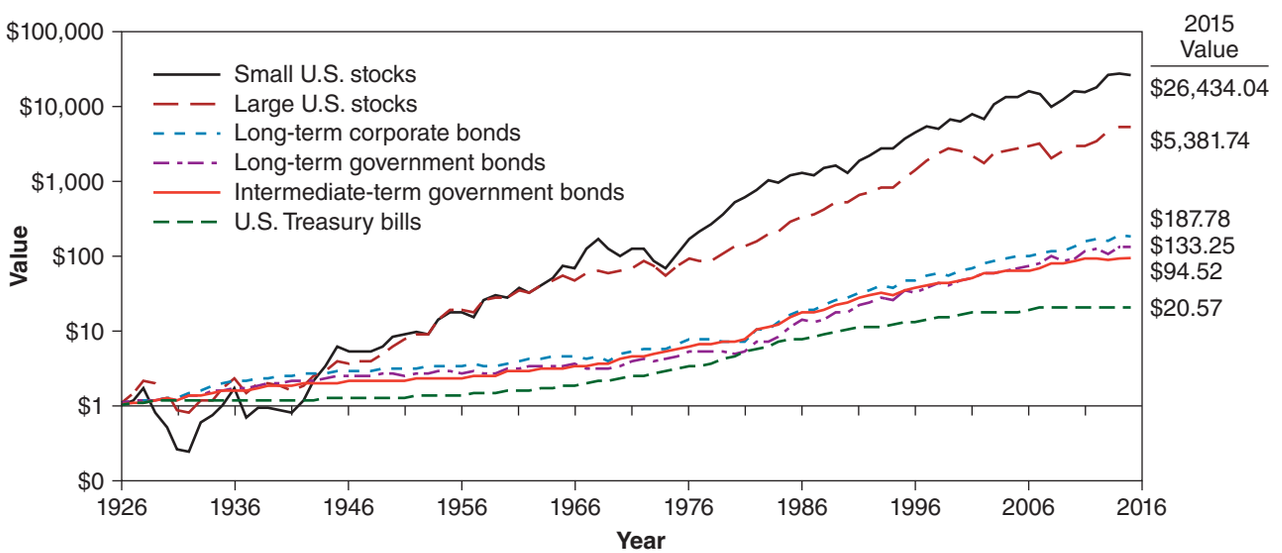


EXHIBIT 7.5 **Cumulative Value of $1 Invested in 1926**

The value of a $1 investment in stocks, small or large, grew much more rapidly than the value of a $1 investment in bonds or Treasury bills over the 1926 to 2015 period. This graph illustrates how earning a higher rate of return over a long period of time can affect the value of an investment portfolio. Although annual stock returns were less certain between 1926 and 2015, the returns on stock investments were much greater.

Source: Data from Morningstar, 2016 SBBI Yearbook

$$R_{\text{Arithmetic average}} = \frac{\sum_{i=1}^{n} R_i}{n} \tag{7.4}$$

Figure 7.17

$$\begin{aligned} FV_n &= PV \times (1 + i)^n \\ \$5{,}381.74 &= \$1 \times (1 + i)^{90} \\ i &= (\$5{,}381.74)^{1/90} - 1 \\ &= 0.1002, \text{ or } 10.02\% \end{aligned}$$

Figure 7.18

$$\begin{aligned} i &= (\$1.25)^{1/2} - 1 \\ i &= [(1 + 0.0695)(1 + 0.1695)]^{1/2} - 1 \end{aligned}$$

$$R_{\text{Geometric average}} = [(1 + R_1) \times (1 + R_2) \times \cdots \times (1 + R_n)]^{1/n} - 1 \tag{7.5}$$

Figure 7.19

Economic Outcome	Probability	AMD Return	Intel Return
Poor	0.2	–0.13	–0.10
Neutral	0.5	0.10	0.07
Good	0.3	0.25	0.22

Figure 7.20

$$\begin{aligned}E(R_{AMD}) &= (p_{Poor} \times R_{Poor}) + (p_{Neutral} \times R_{Neutral}) + (p_{Good} \times R_{Good}) \\ &= (0.2 \times -0.13) + (0.5 \times 0.10) + (0.3 \times 0.25) \\ &= 0.099, \text{ or } 9.9\%\end{aligned}$$

Figure 7.21

$$\begin{aligned}E(R_{Intel}) &= (p_{Poor} \times R_{Poor}) + (p_{Neutral} \times R_{Neutral}) + (p_{Good} \times R_{Good}) \\ &= (0.2 \times -0.10) + (0.5 \times 0.07) + (0.3 \times 0.22) \\ &= 0.081, \text{ or } 8.1\%\end{aligned}$$

Figure 7.22

$$\begin{aligned}\sigma^2_{R_{AMD}} &= \{p_{Poor} \times [R_{Poor} - E(R_{AMD})]^2\} + \{p_{Neutral} \times [R_{Neutral} - E(R_{AMD})]^2\} \\ &\quad + \{p_{Good} \times [R_{Good} - E(R_{AMD})]^2\} \\ &= [0.2 \times (-0.13 - 0.099)^2] + [0.5 \times (0.10 - 0.099)^2] + [0.3 \times (0.25 - 0.099)^2] \\ &= 0.01733 \\ \sigma_{R_{AMD}} &= (\sigma^2_{R_{AMD}})^{1/2} = (0.01733)^{1/2} = 0.13164, \text{ or } 13.164\%\end{aligned}$$

Figure 7.23

$$\begin{aligned}\sigma^2_{R_{Intel}} &= \{p_{Poor} \times [R_{Poor} - E(R_{Intel})]^2\} + \{p_{Neutral} \times [R_{Neutral} - E(R_{Intel})]^2\} \\ &\quad + \{p_{Good} \times [R_{Good} - E(R_{Intel})]^2\} \\ &= [0.2 \times (-0.10 - 0.081)^2] + [0.5 \times (0.07 - 0.081)^2] + [0.3 \times (0.22 - 0.081)^2] \\ &= 0.01241 \\ \sigma_{R_{Intel}} &= (\sigma^2_{R_{Intel}})^{1/2} = (0.01241)^{1/2} = 0.11140, \text{ or } 11.140\%\end{aligned}$$

$$\mathrm{CV}_i = \frac{\sigma_{\mathrm{R}_i}}{\mathrm{E}(\mathrm{R}_i)} \tag{7.6}$$

Figure 7.24

$$\mathrm{CV}_i^* = \frac{\sigma_{\mathrm{R}_i}}{\mathrm{E}(\mathrm{R}_i) - \mathrm{R}_{\mathrm{rf}}}$$

Figure 7.25

$$\mathrm{CV}_{\mathrm{AMD}}^* = \frac{\sigma_{\mathrm{R}_{\mathrm{AMD}}}}{\mathrm{E}(\mathrm{R}_{\mathrm{AMD}}) - \mathrm{R}_{\mathrm{rf}}} = \frac{0.13164}{0.099 - 0.03} = 1.908$$

$$\mathrm{CV}_{\mathrm{Intel}}^* = \frac{\sigma_{\mathrm{R}_{\mathrm{Intel}}}}{\mathrm{E}(\mathrm{R}_{\mathrm{Intel}}) - \mathrm{R}_{\mathrm{rf}}} = \frac{0.11140}{0.081 - 0.03} = 2.184$$

$$\text{Sharpe Ratio} = \mathrm{S} = \frac{\mathrm{E}(\mathrm{R}_i) - \mathrm{R}_{\mathrm{rf}}}{\sigma_{\mathrm{R}_i}} \tag{7.7}$$

Figure 7.26

$$\mathrm{S}_{\mathrm{AMD}} = \frac{1}{\mathrm{CV}_{\mathrm{AMD}}^*} = \frac{\mathrm{E}(\mathrm{R}_{\mathrm{AMD}}) - \mathrm{R}_{\mathrm{rf}}}{\sigma_{\mathrm{R}_{\mathrm{AMD}}}} = \frac{0.099 - 0.03}{0.13164} = 0.524$$

$$\mathrm{S}_{\mathrm{Intel}} = \frac{1}{\mathrm{CV}_{\mathrm{Intel}}^*} = \frac{\mathrm{E}(\mathrm{R}_{\mathrm{Intel}}) - \mathrm{R}_{\mathrm{rf}}}{\sigma_{\mathrm{R}_{\mathrm{Intel}}}} = \frac{0.081 - 0.03}{0.11140} = 0.458$$

LEARNING BY DOING

APPLICATION 7.4 | Calculating and Interpreting the Sharpe Ratio

Problem You are trying to choose between two investments. The first investment, a painting by Picasso, has an expected return of 14 percent with a standard deviation of 30 percent over the next year. The second investment, a pair of blue suede shoes once worn by Elvis, has an expected return of 20 percent with a standard deviation of 40 percent. The risk-free rate of interest is 3 percent. What is the Sharpe Ratio for each of these investments, and what do these ratios tell us?

Approach Use Equation 7.7 to compute the Sharpe Ratios for the two investments.

Solution The Sharpe Ratios are:

$$S_{\text{painting}} = \frac{0.14 - 0.03}{0.3} = 0.367 \quad \text{and} \quad S_{\text{shoes}} = \frac{0.2 - 0.03}{0.4} = 0.425$$

The Sharpe Ratio for Elvis's blue suede shoes is larger than the Sharpe Ratio for the painting. This indicates that the return for each one standard deviation of risk is greater for Elvis's shoes than for the painting. The blue suede shoes are a better investment.

Figure 7.28

$$E(R_{\text{Portfolio}}) = x_1 E(R_1) + x_2 E(R_2)$$

$$E(R_{\text{Portfolio}}) = \sum_{i=1}^{n} [x_i \times E(R_i)] \qquad (7.8)$$
$$= [x_1 \times E(R_1)] + [x_2 \times E(R_2)] + \cdots + [x_n \times E(R_n)]$$

Figure 7.29

$$x_{TB} = \frac{\$100{,}000}{\$400{,}000} = 0.25$$
$$x_{P\&G} = x_{EMC} = \frac{\$150{,}000}{\$400{,}000} = 0.375$$

Figure 7.30

$$\begin{aligned} E(R_{Portfolio}) &= [x_{TB} \times E(R_{TB})] + [x_{P\&G} \times E(R_{P\&G})] + [x_{EMC} \times E(R_{EMC})] \\ &= (0.25 \times 0.045) + (0.375 \times 0.075) + (0.375 \times 0.090) \\ &= 0.0731, \text{ or } 7.31\% \end{aligned}$$

LEARNING BY DOING

APPLICATION 7.5 | Calculating the Expected Return for a Portfolio

Problem You have become concerned that you have too much of your money invested in your pizza restaurant and have decided to diversify your personal portfolio. Right now the pizza restaurant is your only investment. To diversify, you plan to sell 45 percent of your restaurant and invest the proceeds from the sale, in equal proportions, into a stock market index fund and a bond market index fund. Over the next year, you expect to earn a return of 15 percent on your remaining investment in the pizza restaurant, 12 percent on your investment in the stock market index fund, and 8 percent on your investment in the bond market index fund. What return will you expect from your diversified portfolio over the next year?

Approach First, calculate the fraction of your portfolio that will be invested in each type of asset after you have diversified. Then use Equation 7.8 to calculate the expected return on the portfolio.

Solution After you have diversified, 55 percent (100 percent − 45 percent = 55 percent) of your portfolio will be invested in your restaurant, 22.5 percent (45 percent × 0.50 = 22.5 percent) will be invested in the stock market index fund, and 22.5 percent (45 percent × 0.50 = 22.5 percent) will be invested in the bond market index fund. Therefore, from Equation 7.8, we know that the expected return for your portfolio is:

$$\begin{aligned} E(R_{Portfolio}) &= [x_{Rest} \times E(R_{Rest})] + [x_{Stock} \times E(R_{Stock})] + [x_{Bond} \times E(R_{Bond})] \\ &= (0.550 \times 0.15) + (0.225 \times 0.12) + (0.225 \times 0.08) \\ &= 0.1275, \text{ or } 12.75\% \end{aligned}$$

At 12.75 percent, the expected return is an average of the returns on the individual assets in your portfolio, weighted by the fraction of your portfolio that is invested in each.

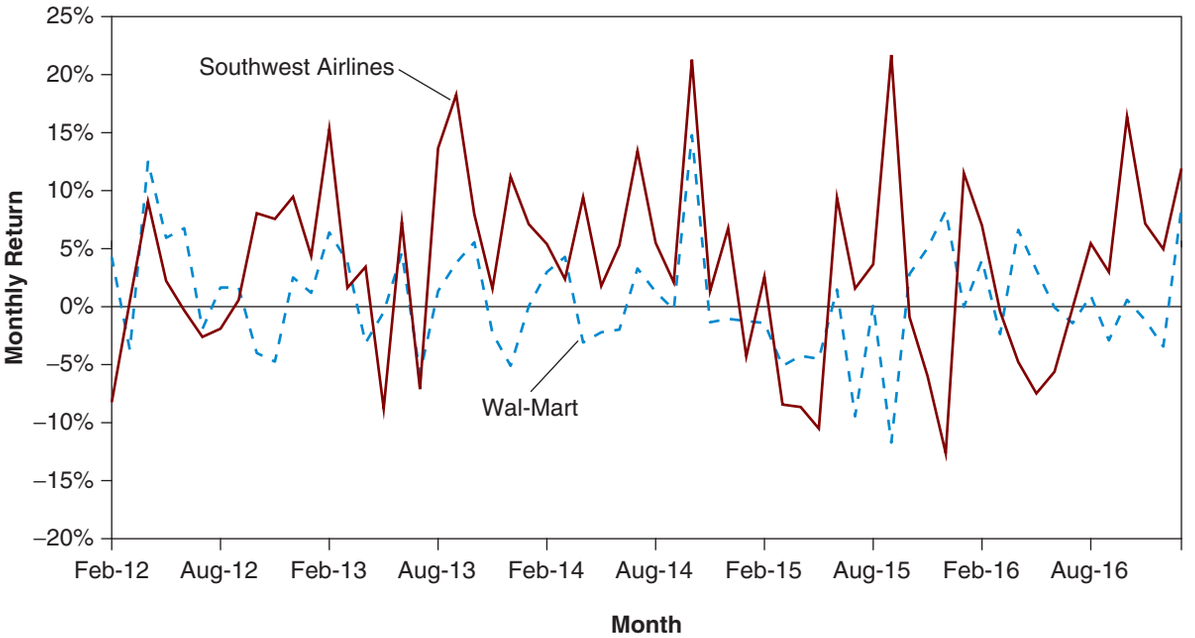


EXHIBIT 7.6 **Monthly Returns for Southwest Airlines and Wal-Mart Stock from February 2012 through January 2017**

The returns on two stocks are generally different. In some periods, the return on one stock is positive, while the return on the other is negative. Even when the returns on both are positive or negative, they are rarely exactly the same.

$$\sigma^2_{R_{\text{2 Asset portfolio}}} = x_1^2\sigma^2_{R_1} + x_2^2\sigma^2_{R_2} + 2x_1x_2\sigma_{R_{1,2}} \tag{7.9}$$

$$\text{Cov}(R_1, R_2) = \sigma_{R_{1,2}} = \sum_{i=1}^{n} \{p_i \times [R_{1,i} - E(R_1)] \times [R_{2,i} - E(R_2)]\} \tag{7.10}$$

Figure 7.31

$$\text{Var}(R) = \sigma^2_R = \sum_{i=1}^{n} \{p_i \times [R_i - E(R)]^2\}$$

$$\rho_{R_{1,2}} = \frac{\sigma_{R_{1,2}}}{\sigma_{R_1}\sigma_{R_2}} \tag{7.11}$$

Figure 7.32

$$\begin{aligned}\sigma^2_{R_{\text{Portfolio of SW and Wal-mart}}} &= x^2_{SW}\sigma^2_{R_{SW}} + x^2_{\text{Wal-Mart}}\sigma^2_{R_{\text{Wal-Mart}}} + 2x_{SW}x_{\text{Wal-Mart}}\sigma_{R_{SW,\ \text{Wal-Mart}}} \\ &= (0.5)^2(0.0729) + (0.5)^2(0.0274) + 2(0.5)(0.5)(0.0067) \\ &= 0.0284\end{aligned}$$

Figure 7.33

$$\rho_{R_{SW,\ \text{Wal-Mart}}} = \frac{\sigma_{R_{SW,\ \text{Wal-Mart}}}}{\sigma_{R_{SW}}\ \sigma_{R_{\text{Wal-Mart}}}} = \frac{0.0067}{0.270 \times 0.166} = 0.149$$

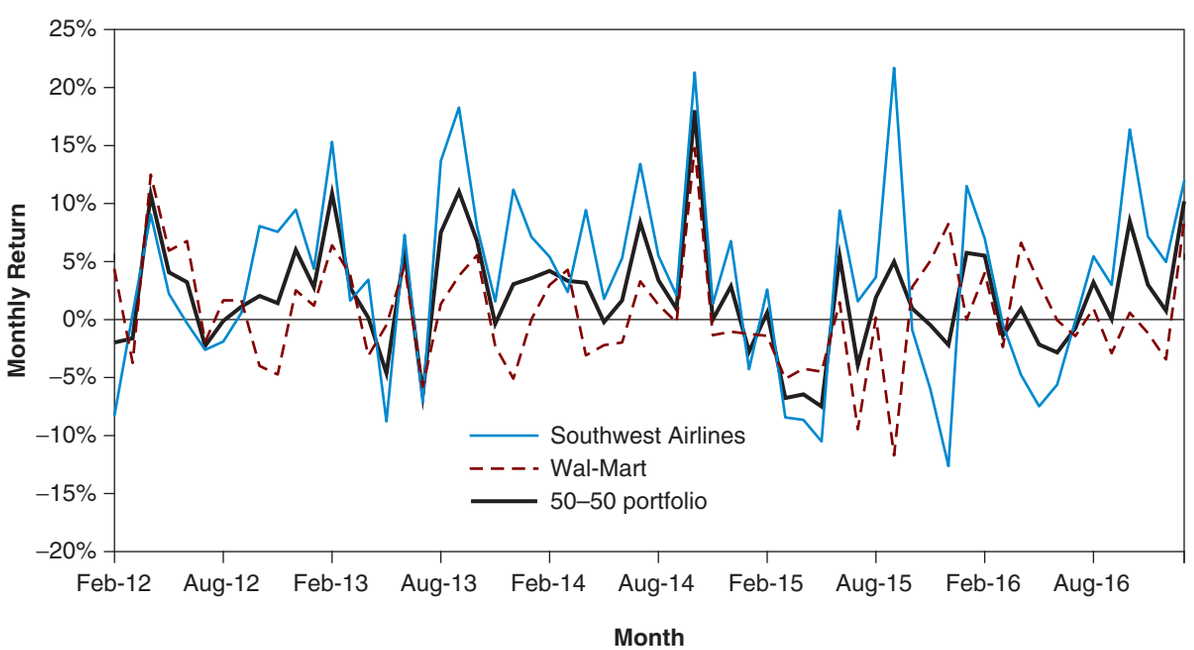


EXHIBIT 7.7 **Monthly Returns for Southwest Airlines and Wal-Mart Stock and for a Portfolio with 50 Percent of the Value in Each of These Two Stocks from February 2012 through January 2017**

The variation in the returns from a portfolio that consists of Southwest Airlines and Wal-Mart stock in equal proportions is less than the variation in the returns from either of those stocks alone.

LEARNING BY DOING

APPLICATION 7.6 | Calculating the Variance of a Two-Asset Portfolio

Problem You are still planning to sell 45 percent of your pizza restaurant in order to diversify your personal portfolio. However, you have now decided to invest all of the proceeds in the stock market index fund. After you diversify, you will have 55 percent of your wealth invested in the restaurant and 45 percent invested in the stock market index fund. You have estimated the variances of the returns for these two investments and the covariance between their returns to be as follows:

$$\sigma^2_{R_{\text{Restaurant}}} = 0.0625$$
$$\sigma^2_{R_{\text{Stock market index}}} = 0.0400$$
$$\sigma_{R_{\text{Restaurant, Stock market index}}} = 0.0250$$

What will be the variance and standard deviation of returns in your portfolio after you have sold the ownership interest in your restaurant and invested in the stock market index fund?

Approach Use Equation 7.9 to calculate the variance of the portfolio returns and then take the square root of this value to obtain the standard deviation.

Solution The variance of the portfolio returns is:

$$\begin{aligned}\sigma^2_{R_{\text{Portfolio}}} &= x^2_{R_{\text{Restaurant}}}\sigma^2_{R_{\text{Restaurant}}} + x^2_{R_{\text{Stock market index}}}\sigma^2_{R_{\text{Stock market index}}} \\ &\quad + 2x_{\text{Restaurant}}x_{\text{Stock market index}}\sigma_{R_{\text{Restaurant Stock market index}}} \\ &= [(0.55)^2 \times 0.0625] + [(0.45)^2 \times 0.0400] + (2 \times 0.55 \times 0.45 \times 0.0250) \\ &= 0.0394\end{aligned}$$

and the standard deviation is $(0.0394)^{1/2} = 0.1985$, or 19.85 percent.

Comparing the variance of the portfolio returns of 0.0394 with the variances of the restaurant returns, 0.0625, and the stock market index fund returns, 0.0400, shows that a portfolio with two or more assets can actually have a smaller variance of returns (and thus a smaller standard deviation of returns) than any of the individual assets in the portfolio.

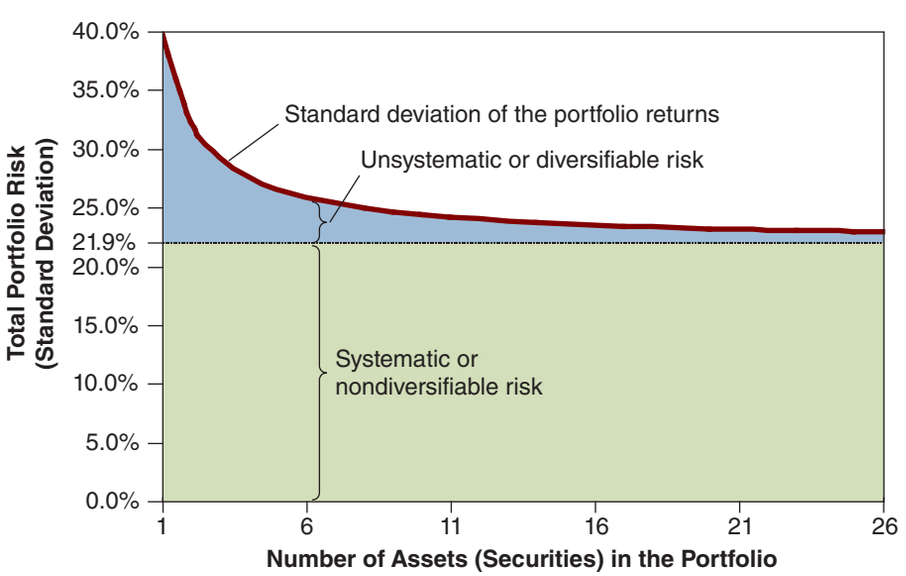


EXHIBIT 7.8 **Total Risk in a Portfolio as the Number of Assets Increases**

The total risk of a portfolio decreases as the number of assets increases. This is because the amount of unsystematic risk in the portfolio decreases. The diversification benefit from adding another asset declines as the total number of assets in the portfolio increases and the unsystematic risk approaches zero. Most of the diversification benefit can often be achieved with as few as 15 or 20 assets.

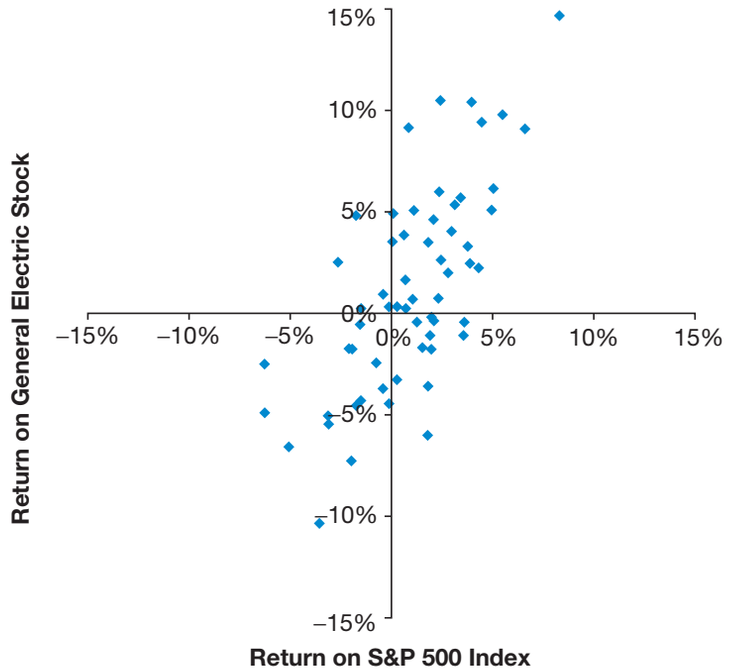


EXHIBIT 7.9 **Plot of Monthly General Electric Company Stock and S&P 500 Index Returns: February 2012 through January 2017**

The monthly returns on General Electric stock are positively related to the returns on the S&P 500 Index. In other words, the return on General Electric's stock tends to be higher when the return on the S&P 500 Index is higher and lower when the return on the S&P 500 Index is lower.

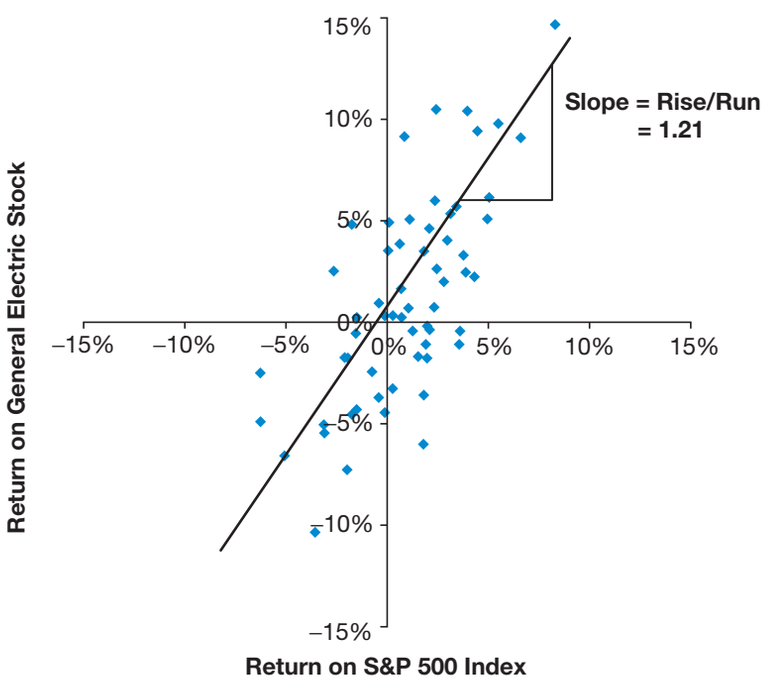


EXHIBIT 7.10 **Slope of Relation between General Electric Company Monthly Stock Returns and S&P 500 Index Returns: February 2012 through January 2017**

The line shown in the exhibit best represents the relation between the monthly returns on General Electric stock and the returns on the S&P 500 Index. The slope of this line, which equals 1.21, indicates that the return on General Electric stock tends to equal about 1.21 times the return on the S&P 500 Index.

Figure 7.33

$$E(R_i) = R_{rf} + \text{Compensation for taking risk}_i$$

Figure 7.34

$$E(R_i) = R_{rf} + (\text{Units of systematic risk}_i \times \text{Compensation per unit of systematic risk})$$

$$E(R_i) = R_{rf} + \beta_i[E(R_m) - R_{rf}] \tag{7.12}$$

Figure 7.35

$$\begin{aligned} E(R_i) &= R_{rf} + \beta_i[E(R_m) - R_{rf}] \\ &= 0.04 + [1.5 \times (0.10 - 0.04)] = 0.13, \text{ or } 13\% \end{aligned}$$

Figure 7.36

$$R_T = \frac{\Delta P + CF_1}{P_0}$$

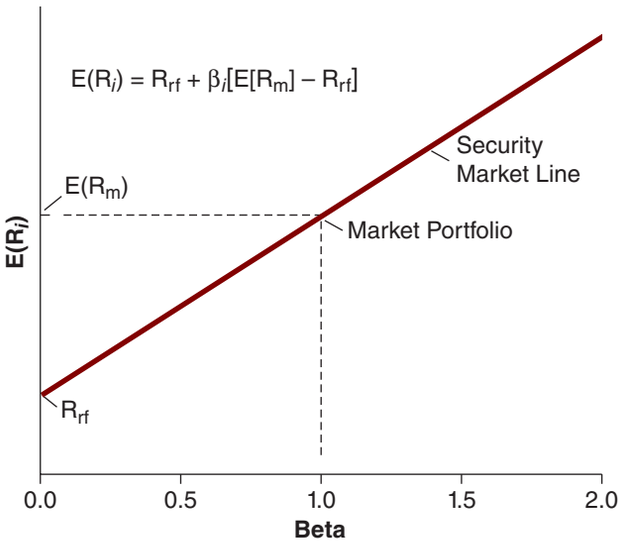


EXHIBIT 7.11 **The Security Market Line**

The Security Market Line (SML) is the line that shows the relation between expected return and systematic risk, as measured by beta. When beta equals 0 and there is no systematic risk, the expected return equals the risk-free rate. As systematic risk (beta) increases, the expected return increases. This is an illustration of the positive relation between risk and return. The SML shows that it is systematic risk that matters to investors.

LEARNING BY DOING

APPLICATION 7.7 | Expected Returns and Systematic Risk

Problem You are considering buying 100 shares of General Electric stock. The Yahoo Finance Web site reports that the beta for General Electric is 1.21. The risk-free rate is 4 percent, and the market risk premium is 6 percent. What is the expected rate of return on General Electric stock according to the CAPM?

Approach Use Equation 7.12 to calculate the expected return on General Electric stock.

Solution The expected return is:

$$E(R_{GE}) = R_{rf} + \beta_{GE}[E(R_m) - R_{rf}]$$
$$= 0.04 + (1.21 \times 0.06) = 0.1126, \text{ or } 11.26\%$$

EXAMPLE 7.2 | Choosing between Two Investments

DECISION MAKING

Situation You are trying to decide whether to invest in one or both of two different stocks. Stock 1 has a beta of 0.8 and an expected return of 7.0 percent. Stock 2 has a beta of 1.2 and an expected return of 9.5 percent. You remember learning about the CAPM in school and believe that it does a good job of telling you what the appropriate expected return should be for a given level of risk. Since the risk-free rate is 4 percent and the market risk premium is 6 percent, the CAPM tells you that the appropriate expected rate of return for an asset with a beta of 0.8 is 8.8 percent. The corresponding return for an asset with a beta of 1.2 is 11.2 percent. Should you invest in either or both of these stocks?

Decision You should not invest in either stock. The expected returns for both of them are below the values predicted by the CAPM for investments with the same level of risk. In other words, both would plot below the line in Exhibit 7.11. This implies that they are both overpriced.

Figure 7.37

$$E(R_{n\ \text{Asset portfolio}}) = R_{rf} + \beta_{n\ \text{Asset portfolio}}[E(R_m) - R_{rf}]$$

Figure 7.38

$$E(R_{\text{Portfolio}}) = \sum_{i=1}^{n} [x_i \times E(R_i)]$$
$$= [x_1 \times E(R_1)] + [x_2 \times E(R_2)] + \cdots + [x_n \times E(R_n)]$$

$$\beta_{n\ \text{Asset portfolio}} = \sum_{i=1}^{n} x_i\beta_i = x_1\beta_1 + x_2\beta_2 + x_3\beta_3 + \cdots + x_n\beta_n \qquad (7.13)$$

Figure 7.39

$$\begin{aligned}\beta_{\text{Portfolio}} &= x_{\text{Fund}}\beta_{\text{Fund}} + x_{\text{TB}}\beta_{\text{TB}} + x_{\text{House}}\beta_{\text{House}}\\ &= (0.25 \times 1.0) + (0.25 \times 0.0) + (0.50 \times 2.0)\\ &= 1.25\end{aligned}$$

Figure 7.40

$$\begin{aligned}E(R_{\text{Portfolio}}) &= R_{rf} + \beta_{\text{Portfolio}}[E(R_m) - R_{rf}]\\ &= 0.04 + (1.25 \times 0.06) = 0.115, \text{ or } 11.5\%\end{aligned}$$

LEARNING BY DOING

APPLICATION 7.8 | Portfolio Risk and Expected Return

Problem You have recently become very interested in real estate. To gain some experience as a real estate investor, you have decided to get together with nine of your friends to buy three small cottages near campus. If you and your friends pool your money, you will have just enough to buy the three properties. Since each investment requires the same amount of money and you will have a 10 percent interest in each, you will effectively have one-third of your portfolio invested in each cottage.

While the cottages cost the same, they are different distances from campus and in different neighborhoods. You believe that this causes them to have different levels of systematic risk, and you estimate that the betas for the individual cottages are 1.2, 1.3, and 1.5. If the risk-free rate is 4 percent and the market risk premium is 6 percent, what will be the expected return on your real estate portfolio after you make all three investments?

Approach There are two approaches that you can use to solve this problem. First, you can estimate the expected return for each cottage using Equation 7.12 and then calculate the expected return on the portfolio using Equation 7.8. Alternatively, you can calculate the beta for the portfolio using Equation 7.13 and then use Equation 7.12 to calculate the expected return.

Solution Using the first approach, we find that Equation 7.12 gives us the following expected returns:

$$\begin{aligned}E(R_i) &= R_{rf} + \beta_i[E(R_m) - R_{rf}]\\ &= 0.04 + (1.2 \times 0.06) = 0.112, \text{ or } 11.2\%, \text{ for cottage 1}\\ &= 0.04 + (1.3 \times 0.06) = 0.118, \text{ or } 11.8\%, \text{ for cottage 2}\\ &= 0.04 + (1.5 \times 0.06) = 0.130, \text{ or } 13.0\%, \text{ for cottage 3}\end{aligned}$$

Therefore, from Equation 7.8, the expected return on the portfolio is:

$$\begin{aligned}E(R_{\text{Portfolio}}) &= [x_1 \times E(R_1)] + [x_2 \times E(R_2)] + [x_3 \times E(R_3)]\\ &= (1/3 \times 0.112) + (1/3 \times 0.118) + (1/3 \times 0.13) = 0.12, \text{ or } 12.0\%\end{aligned}$$

Using the second approach, from Equation 7.13, the beta of the portfolio is:

$$\beta_{\text{Portfolio}} = x_1\beta_1 + x_2\beta_2 + x_3\beta_3 = (1/3)(1.2) + (1/3)(1.3) + (1/3)(1.5) = 1.33333$$

and from Equation 7.12, the expected return is:

$$\begin{aligned}E(R_{\text{Portfolio}}) &= R_{rf} + \beta_{\text{Portfolio}}[E(R_m) - R_{rf}]\\ &= 0.04 + (1.33333 \times 0.06) = 0.120, \text{ or } 12.0\%\end{aligned}$$

Summary of Key Equations

Equation	Description	Formula
7.1	Total holding period return	$R_T = R_{CA} + R_I = \frac{P_1 - P_0}{P_0} + \frac{CF_1}{P_0} = \frac{\Delta P + CF_1}{P_0}$
7.2	Expected return on an asset	$E(R_{Asset}) = \sum_{i=1}^{n} (p_i \times R_i)$
7.3	Variance of return on an asset	$Var(R) = \sigma_R^2 = \sum_{i=1}^{n} \{p_i \times [R_i - E(R)^2]\}$
7.4	Arithmetic average return	$R_{Arithmetic\ average} = \frac{\sum_{i=1}^{n} R_i}{n}$
7.5	Geometric (compounded) average return	$R_{Geometric\ average} = [(1 + R_1) \times (1 + R_2) \times \cdots \times (1 + R_n)]^{1/n} - 1$
7.6	Coefficient of variation	$CV_i = \frac{\sigma_{R_i}}{E(R_i)}$
7.7	Sharpe Ratio	$S = \frac{E(R_i) - R_{rf}}{\sigma_{R_i}}$
7.8	Expected return for a portfolio	$E(R_{Portfolio}) = \sum_{i=1}^{n} [x_i \times E(R_i)]$
7.9	Variance for a two-asset portfolio	$\sigma^2_{R_{2Asset\ portfolio}} = x_1^2\sigma^2_{R_1} + x_2^2\sigma^2_{R_2} + 2x_1x_2\sigma_{R_{1,2}}$
7.10	Covariance of returns between two assets	$\sigma_{R_{1,2}} = \sum_{i=1}^{n} \{p_i \times [R_{1,i} - E(R_1)] \times [R_{2,i} - E(R_2)]\}$
7.11	Correlation between the returns on two assets	$\rho_{R_{1,2}} = \frac{\sigma_{R_{1,2}}}{\sigma_{R_1}\sigma_{R_2}}$
7.12	Expected return and systematic risk	$E(R_i) = R_{rf} + \beta_i[E(R_m) - R_{rf}]$
7.13	Portfolio beta	$\beta_{n\ Asset\ portfolio} = \sum_{i=1}^{n} x_i\beta_i$

Self-Study Problems

7.1 Kaaran made a friendly wager with a colleague that involves the result from flipping a coin. If heads comes up, Kaaran must pay her colleague $15; otherwise, her colleague will pay Kaaran $15. What is Kaaran's expected cash flow, and what is the variance of that cash flow if the coin has an equal probability of coming up heads or tails? Suppose Kaaran's colleague is willing to handicap the bet by paying her $20 if

the coin toss results in tails. If everything else remains the same, what are Kaaran's expected cash flow and the variance of that cash flow?

7.2 You know that the price of CFI, Inc., stock will be $12 exactly one year from today. Today the price of the stock is $11. Describe what must happen to the price of CFI, Inc., today in order for an investor to generate a 20 percent return over the next year. Assume that CFI does not pay dividends.

7.3 The expected value of a normal distribution of prices for a stock is $50. If you are 90 percent sure that the price of the stock will be between $40 and $60, then what is the variance of the stock price?

7.4 During the period from 2011 through 2015 the annual returns on small U.S. stocks were −3.26 percent, 18.23 percent, 45.07 percent, 2.92 percent, and −3.60 percent, respectively. What would a $1 investment, made at the beginning of 2011, have been worth at the end of 2015? What average annual return would have been earned on this investment?

7.5 You must choose between investing in Stock A or Stock B. You have already used CAPM to calculate the rate of return you should expect to receive for each stock given each one's systematic risk and decided that the expected return for both exceeds that predicted by CAPM by the same amount. In other words, both are equally attractive investments for a diversified investor. However, since you are still in school and do not have a lot of money, your investment portfolio is not diversified. You have decided to invest in the stock that has the highest expected return per unit of total risk. If the expected return and standard deviation of returns for Stock A are 10 percent and 25 percent, respectively, and the expected return and standard deviation of returns for Stock B are 15 percent and 40 percent, respectively, which should you choose? Assume that the risk-free rate is 5 percent.

7.6 CSB, Inc., stock has a beta of 1.35. If the expected market return is 14.5 percent and the risk-free rate is 5.5 percent, what does CAPM indicate the appropriate expected return for CSB stock is?

Solutions to Self-Study Problems

7.1 Part 1: $E(\text{cash flow}) = (0.5 \times -\$15) + (0.5 \times \$15) = 0$

$$\sigma^2_{\text{Cash flow}} = [0.5 \times (-\$15 - \$0)^2] + [0.5 \times (\$15 - \$0)^2] = 225$$

Part 2: $E(\text{cash flow}) = (0.5 \times -\$15) + (0.5 \times \$20) = \$2.50$

$$\sigma^2_{\text{Cash flow}} = [0.5 \times (-\$15 - \$2.50)^2] + [0.5 \times (\$20 - \$2.50)^2] = 306.25$$

7.2 The expected return for CFI based on today's stock price is (\$12 − \$11)/\$11 = 9.09 percent, which is lower than 20 percent. Since the stock price one year from today is fixed, the only way that you will generate a 20 percent return is if the price of the stock drops today. Consequently, the price of the stock today must drop to \$10. It is found by solving the following: $0.2 = (\$12 - x)/x$, or $x = \$10$.

7.3 Since you know that 1.645 standard deviations around the expected return captures 90 percent of the distribution, you can set up either of the following equations:

$$\$40 = \$50 - 1.645\sigma \quad \text{or} \quad \$60 = \$50 + 1.645\sigma$$

and solve for σ. Doing this with either equation yields:

$$\sigma = \$6.079 \text{ and } \sigma^2 = 36.954$$

7.4 The value in 2015 is:

$$V_{2015} = \$1 \times (1 + -0.0326) \times (1 + 0.1823) \times (1 + 0.4507) \times (1 + 0.0292) \times (1 + -0.0360)$$
$$= \$1.646$$

Substituting into Equation 7.4 and solving for the geometric average yields:

$$R_{\text{Geometric average}} = [(1 + R_1) \times (1 + R_2) \times \cdots \times (1 + R_n)]^{1/n} - 1$$
$$= [\$1.646]^{1/5} - 1$$
$$= 0.1048, \text{ or } 10.48 \text{ per year}$$

7.5 A comparison of the Sharpe Ratios for the two stocks will tell you which has the higher expected return per unit of total risk.

$$S_A = \frac{E(R_A) - R_{rf}}{\sigma_{R_A}} = \frac{0.10 - 0.05}{0.25} = 0.20$$

$$S_B = \frac{E(R_B) - R_{rf}}{\sigma_{R_B}} = \frac{0.15 - 0.05}{0.40} = 0.25$$

You should invest in Stock B because it has the highest expected return per unit of risk.

7.6 $E(R_{CSB}) = R_{rf} + \beta_{CSB}[E(R_M) - R_{rf}] = 0.055 + [1.35 \times (0.145 - 0.055)] = 0.1765$ or, 17.65%

Discussion Questions

7.1 Suppose that you know the risk and the expected return for two stocks. Discuss the process you might utilize to determine which of the two stocks is a better buy. You may assume that the two stocks will be the only assets held in your portfolio.

7.2 What is the difference between the expected rate of return and the required rate of return? What does it mean if they are different for a particular asset at a particular point in time?

7.3 Suppose that the standard deviation of the returns on the shares of stock at two different companies is exactly the same. Does this mean that the required rate of return will be the same for these two stocks? How might the required rate of return on the stock of a third company be greater than the required rates of return on the stocks of the first two companies even if the standard deviation of the returns of the third company's stock is lower?

7.4 The correlation between Stocks A and B is 0.50, while the correlation between Stocks A and C is −0.5. You already own Stock A and are thinking of buying either Stock B or stock C. If you want your portfolio to have the lowest possible risk, would you buy Stock B or C? Would you expect the stock you choose to affect the return that you earn on your portfolio?

7.5 The idea that we can know the return on a security for each possible outcome is overly simplistic. However, even though we cannot possibly predict all possible outcomes, this fact has little bearing on the risk-free return. Explain why.

7.6 Which investment category included in Exhibit 7.3 has shown the greatest degree of risk in the United States since 1926? Explain why that makes sense in a world where the value of an asset in this investment category is likely to be more sensitive to changes in market conditions than is the price of a corporate bond.

7.7 You are concerned about one of the investments in your fully diversified portfolio. You just have an uneasy feeling about the CFO, Iam Shifty, of that particular firm. You do believe, however, that the firm makes a good product and that it is appropriately priced by the market. Should you be concerned about the effect on your portfolio if Shifty embezzles a portion of the firm's cash?

7.8 The CAPM is used to price the risk (estimate the expected return) for any asset. Our examples have focused on stocks, but we could also use CAPM to estimate the expected rate of return for bonds. Explain why.

7.9 In recent years, investors have agreed that the market portfolio consists of more than just a group of U.S. stocks and bonds. If you are an investor who invests in only U.S. stocks and bonds, describe the effects on the risk in your portfolio.

7.10 You may have heard the statement that you should not include your home as an asset in your investment portfolio. Assume that your house will comprise up to 75 percent of your assets in the early part of your investment life. Evaluate the implications of omitting it when calculating the risk of your overall investment portfolio.

Questions and Problems

Basic

7.1 Returns: Describe the difference between a total holding period return and an expected return.

7.2 Expected returns: John is watching an old game show rerun on television called *Let's Make a Deal* in which the contestant chooses a prize behind one of two curtains. Behind one of the curtains is a gag prize worth $150, and behind the other is a round-the-world trip worth $7,200. The producer of the game show has placed a subliminal message on the curtain containing the gag prize, which makes the probability of choosing the gag prize equal to 75 percent. What is the expected value of the selection, and what is the standard deviation of that selection?

7.3 Expected returns: You have chosen biology as your college major because you would like to be a medical doctor. However, you find that the probability of being accepted to medical school is about 10 percent. If you are accepted to medical school, then your starting salary when you graduate will be $300,000 per year. However, if you are not accepted, then you would choose to work in a zoo, where you will earn $40,000 per year. Without considering the additional years you would spend in school if you study medicine or the time value of money, what is your expected starting salary as well as the standard deviation of that starting salary?

7.4 Historical market: Describe the general relation between risk and return that we observe in the historical bond and stock market data.

7.5 Single-asset portfolios: Stocks A, B, and C have expected returns of 15 percent, 15 percent, and 12 percent, respectively, while their standard deviations are 45 percent, 30 percent, and 30 percent, respectively. If you were considering the purchase of each of these stocks as the only holding in your portfolio and the risk-free rate is 0 percent, which stock should you choose?

7.6 Arithmetic average: Tanner invested $1,000 in large U.S. stocks at the beginning of 2012. This investment earned 15.98 percent in 2012, 32.41 percent in 2013, 13.69 percent in 2014, and 1.41 percent in 2015. What return did he earn in the average year during the 2012–2015 period?

7.7 Geometric average: What was the average annual return that Tanner earned over the 2012–2015 period in Problem 7.6?

7.8 Diversification: Describe how investing in more than one asset can reduce risk through diversification.

7.9 Systematic risk: Define systematic risk.

7.10 Measuring systematic risk: Susan is expecting the returns on the market portfolio to be negative in the near term. Since she is managing a stock mutual fund, she must remain invested in a portfolio of stocks. However, she is allowed to adjust the beta of her portfolio. What kind of beta would you recommend for Susan's portfolio?

7.11 Measuring systematic risk: Describe and justify what the value of the beta of a U.S. Treasury bill should be.

7.12 Measuring systematic risk: If the expected rate of return for the market is not much greater than the risk-free rate of return, what does this suggest about the general level of compensation for bearing systematic risk?

7.13 CAPM: Describe the Capital Asset Pricing Model (CAPM) and what it tells us.

7.14 The Security Market Line: If the expected return on the market is 10 percent and the risk-free rate is 4 percent, what is the expected return for a stock with a beta equal to 1.5? What is the market risk premium?

Intermediate

7.15 Expected returns: José is thinking about purchasing a soft drink machine and placing it in a business office. He knows that there is a 5 percent probability that someone who walks by the machine will make a purchase from the machine, and he knows that the profit on each soft drink sold is $0.10. If José expects a thousand people per day to pass by the machine and requires a complete return of his investment in one year, then what is the maximum price that he should be willing to pay for the soft drink machine? Assume 250 working days in a year, and ignore taxes and the time value of money.

7.16 Interpreting the variance and standard deviation: The distribution of grades in an introductory finance class is normally distributed, with an expected grade of 75. If the standard deviation of grades is 7, in what range would you expect 95 percent of the grades to fall?

7.17 Calculating the variance and standard deviation: Kate recently invested in real estate with the intention of selling the property one year from today. She has modeled the returns on that investment based on three economic scenarios. She believes that if the economy stays healthy, then her investment will generate a 30 percent return. However, if the economy softens, as predicted, the return will be 10 percent, while the return will be −25 percent if the economy slips into a recession. If the probabilities of the healthy, soft, and recessionary states are 0.4, 0.5, and 0.1, respectively, then what are the expected return and the standard deviation of the return on Kate's investment?

7.18 Calculating the variance and standard deviation: Barbara is considering investing in a company's stock and is aware that the return on that investment is particularly sensitive to how the economy is performing. Her analysis suggests that four states of the economy can affect the return on the investment. Using the table of returns and probabilities that follows, find the expected return and the standard deviation of the return on Barbara's investment.

	Probability	Return
Boom	0.1	25.00%
Good	0.4	15.00%
Level	0.3	10.00%
Slump	0.2	−5.00%

7.19 Calculating the variance and standard deviation: Ben would like to invest in gold and is aware that the returns on such an investment can be quite volatile. Use the following table of states, probabilities, and returns to determine the expected return and the standard deviation of the return on Ben's gold investment.

	Probability	Return
Boom	0.1	40.00%
Good	0.2	30.00%
OK	0.3	15.00%
Level	0.2	2.00%
Slump	0.2	−12.00%

7.20 Single-asset portfolios: Using the information from Problems 7.17, 7.18, and 7.19, calculate the coefficient of variation for each of the investments in those problems.

7.21 Portfolios with more than one asset: Emmy is analyzing a two-stock portfolio that consists of a utility stock and a commodity stock. She knows that the return on the utility stock has a standard deviation of 40 percent and the return on the commodity stock has a standard deviation of 30 percent. However, she does not know the exact covariance in the returns of the two stocks. Emmy would like to plot the variance of the portfolio for each of three cases—covariance of 0.12, 0, and −0.12—in order to understand what the variance of the portfolio would be for a range of covariances. Do the calculation for all three cases (0.12, 0, and −0.12), assuming an equal proportion of each stock in the portfolio.

7.22 Portfolios with more than one asset: Given the returns and probabilities for the three possible states listed below, calculate the covariance between the returns of Stock A and Stock B. For convenience, assume that the expected returns of Stock A and Stock B are 11.75 percent and 18 percent, respectively.

	Probability	Return on Stock A	Return on Stock B
Good	0.35	0.30	0.50
OK	0.50	0.10	0.10
Poor	0.15	−0.25	−0.30

7.23 Compensation for bearing systematic risk: You have constructed a diversified portfolio of stocks such that there is no unsystematic risk. Explain why the expected return of that portfolio should be greater than the expected return of a risk-free security.

7.24 Compensation for bearing systematic risk: Write out the equation for the covariance in the returns of two assets, Asset 1 and Asset 2. Using that equation, explain the easiest way for the two asset returns to have a covariance of zero.

7.25 Compensation for bearing systematic risk: Evaluate the following statement: "By fully diversifying a portfolio, such as by buying every asset in the market, we can completely eliminate all types of risk, thereby creating a synthetic Treasury bill."

7.26 CAPM: Damien knows that the beta of his portfolio is equal to 1, but he does not know the risk-free rate of return or the market risk premium. He also knows that the expected return on the market is 8 percent. What is the expected return on Damien's portfolio?

7.27 CAPM: In February 2017 the risk-free rate was 2.97 percent, the market risk premium was 6 percent, and the beta for Twitter stock was 0.99. What is the expected return that was consistent with the systematic risk associated with the returns on Twitter stock?

7.28 CAPM: The market risk premium is 6 percent, and the risk-free rate is 5 percent. If the expected return on a bond is 6.5 percent, what is its beta?

Advanced

7.29 David is going to purchase two stocks to form the initial holdings in his portfolio. Iron stock has an expected return of 15 percent, while Copper stock has an expected return of 20 percent. If David plans to invest 30 percent of his funds in Iron and the remainder in Copper, what will be the expected return from his portfolio? What if David invests 70 percent of his funds in Iron stock?

7.30 Peter knows that the covariance in the return on two assets is −0.0025. Without knowing the expected return of the two assets, explain what that covariance means.

7.31 In order to fund her retirement, Glenda needs her portfolio to have an expected return of 12 percent per year over the next 30 years. She has decided to invest in Stocks 1, 2, and 3, with 25 percent in Stock 1, 50 percent in Stock 2, and 25 percent in Stock 3. If Stocks 1 and 2 have expected returns of 9 percent and 10 percent per year, respectively, then what is the minimum expected annual return for Stock 3 that is likely to enable Glenda to achieve her investment requirement?

7.32 Tonalli is putting together a portfolio of 10 stocks in equal proportions. What is the relative importance of the variance for each stock versus the covariance for the pairs of stocks in her portfolio? For this exercise, ignore the actual values of the variance and covariance terms and explain their importance conceptually.

7.33 Explain why investors who have diversified their portfolios will determine the price and, consequently, the expected return on an asset.

7.34 Brad is about to purchase an additional asset for his well-diversified portfolio. He notices that when he plots the historical returns of the asset against those of the market portfolio, the line of best fit tends to have a large amount of prediction error for each data point (the scatter plot is not very tight around the line of best fit). Do you think that this will have a large or a small impact on the beta of the asset? Explain your opinion.

7.35 Draw the Security Market Line (SML) for the case where the market risk premium is 5 percent and the risk-free rate is 7 percent. Now suppose an asset has a beta of −1.0 and an expected return of 4 percent. Plot it on your graph. Is the security properly priced? If not, explain what we might expect to happen to the price of this security in the market. Next, suppose another asset has a beta of 3.0 and an expected return of 20 percent. Plot it on the graph. Is this security properly priced? If not, explain what we might expect to happen to the price of this security in the market.

7.36 If the CAPM describes the relation between systematic risk and expected returns, can both an individual asset and the market portfolio of all risky assets have negative expected real rates of return? Why or why not?

7.37 You have been provided the following data on the securities of three firms and the market:

Security	$E[R_i]$	σ_{R_i}	ρ	β_i
Stock A	0.15		1.0	1.5
Stock B	0.15	0.18	0.5	
Stock C	0.10	0.02		0.5
Market portfolio	0.10	0.04		
Treasury bills	0.05	0		

Assume the CAPM and SML are true and fill in the missing values in the table. Would you invest in the stock of any of the three firms? If so, which one(s) and why?

Sample Test Problems

7.1 Given the following information from Capstone Corporation, what price would the CAPM predict that the company's stock will trade for one year from today?

Risk free rate: 3%

Market risk premium: 8%

Beta: 0.65

Current stock price: $64.61

Annual dividend: $1.92

7.2 You are considering investing in a mutual fund. The fund is expected to earn a return of 15 percent in the next year. If its annual return is normally distributed with a standard deviation of 6.5 percent, what return can you expect the fund to beat 95 percent of the time?

7.3 You have just invested in a portfolio of three stocks. The amount of money that you invested in each stock and its beta are summarized below. Calculate the beta of the portfolio and use the Capital Asset Pricing Model (CAPM) to compute the expected rate of return for the portfolio. Assume that the expected rate of return on the market is 15 percent and that the risk-free rate is 7 percent.

Stock	Investment	Beta
A	$200,000	1.50
B	300,000	0.65
C	500,000	1.25

7.4 What would you recommend to an investor who is considering making an investment in a stock that plots *below* the Security Market Line (SML)? Explain.

7.5 Why does an investor want a diversified portfolio? Can an investor eliminate all risk?

Figure 8.1

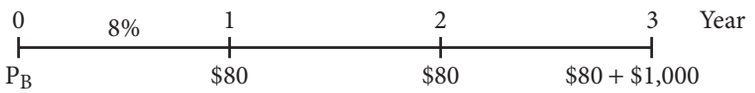


Figure 8.2

$$P_B = \text{PV(Coupon payments)} + \text{PV(Principal payment)}$$

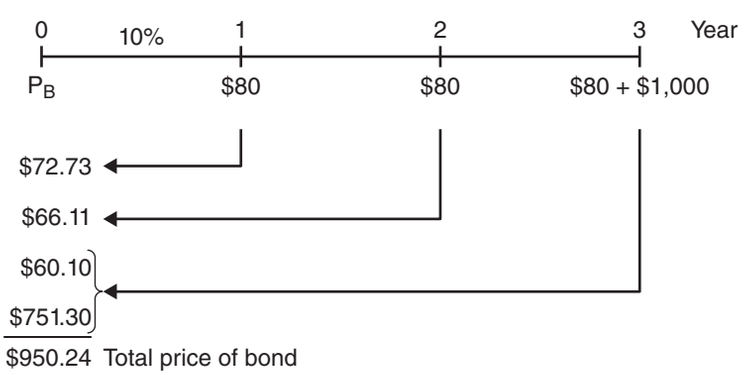


EXHIBIT 8.1 **Cash Flows for a Three-Year Bond**

The exhibit shows a time line for a three-year bond that pays an 8 percent coupon rate and has a face value of $1,000. How much should we pay for such a bond if the market rate of interest is 10 percent? To solve this problem, we discount the promised cash flows to the present and then add them up.

Figure 8.3

$$
\begin{aligned}
P_B &= \text{PV (Each coupon payment)} + \text{PV (Principle payment)} \\
&= \left[\frac{C_1}{(1+i)}\right] + \left[\frac{C_2}{(1+i)^2}\right] + \left[\frac{C_3}{(1+i)^3}\right] + \left[\frac{F_3}{(1+i)^3}\right] \\
&= \left[\frac{\$80}{1.10}\right] + \left[\frac{\$80}{(1.10)^2}\right] + \left[\frac{\$80}{(1.10)^3}\right] + \left[\frac{\$1{,}000}{(1.10)^3}\right] \\
&= \left[\frac{\$80}{1.10}\right] + \left[\frac{\$80}{1.21}\right] + \left[\frac{\$80}{1.331}\right] + \left[\frac{\$1{,}000}{1.331}\right] \\
&= \$72.73 + \$66.11 + \$60.10 + \$751.30 \\
&= \$950.24
\end{aligned}
$$

Figure 8.4

$$
\begin{aligned}
P_B &= \left[\frac{C_1}{(1+i)}\right] + \left[\frac{C_2}{(1+i)^2}\right] + \cdots + \left[\frac{C_n}{(1+i)^n}\right] + \left[\frac{F_n}{(1+i)^n}\right] \\
&= \left[\frac{C_1}{(1+i)}\right] + \left[\frac{C_2}{(1+i)^2}\right] + \cdots + \left[\frac{(C_n + F_n)}{(1+i)^n}\right]
\end{aligned}
$$

$$
P_B = \frac{C_1}{1+i} + \frac{C_2}{(1+i)^2} + \cdots + \frac{C_n + F_n}{(1+i)^n} \tag{8.1}
$$

Figure 8.5

Enter	3	10		80	1,000
	N	i	PV	PMT	FV
Answer			**−950.26**		

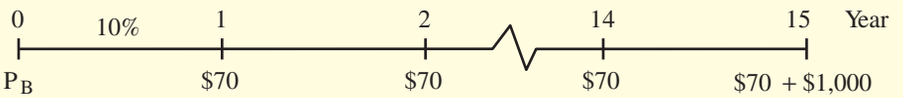
Figure 8.6

$$
\begin{aligned}
P_B &= \frac{\$50}{1.05} + \frac{\$50}{(1.05)^2} + \frac{\$1{,}050}{(1.05)^3} \\
&= \$47.62 + \$45.35 + \$907.03 \\
&= \$1{,}000
\end{aligned}
$$

APPLICATION 8.1 | Pricing a Bond

LEARNING BY DOING

Problem Your stockbroker is trying to sell you a 15-year bond with a 7 percent coupon, and the interest, or yield, on similar bonds is 10 percent. Is the bond selling for a premium, at par, or at a discount? Answer the question without making any calculations, and then prove that your answer is correct. The time line is as follows:



Approach Since the market rate of interest is greater than the coupon rate ($i >$ coupon rate), the bond must sell at a discount.

Solution To prove the answer is correct (or wrong), we can compute the bond's price with a financial calculator.

Enter	15	10		70	1,000
	N	i	PV	PMT	FV
Answer			**−771.82**		

The bond is selling at a discount, and it should. Why? The market rate of interest is 10 percent, and the bond is paying only 7 percent. Since the bond's coupon rate is fixed, the only way we can bring the bond's yield up to the current market rate of 10 percent is to reduce the price of the bond to $771.82.

Using Excel

Bond Prices and Yields

Calculating bond prices and yields using a spreadsheet may seem daunting at first. However, understanding the terminology used in the formulas will make the calculations a matter of common sense:

Settlement date—the date a buyer purchases the bond.

Maturity date—the date the bond expires. If you know only the "*n*" (number of years remaining) of the bond, use a date that is *n* years in the future in this field.

Redemption—the security's redemption value per $10 face value. In other words, if the bond has a par value of $1,000, you enter 100 in this field.

Frequency—the number of coupon payments per year.

Here is a spreadsheet showing the setup for calculating the price of the discount bond described in Learning by Doing Application 8.1.

	A	B	C	D
1				
2	**Bond Price Calculations**			
3	**Inputs**			
4	Settlement date	1/1/17		
5	Maturity date	1/1/32		
6	Rate	0.07		
7	Yield	0.10		
8	Redemption (% of par)	100		
9	Frequency	1		
10				
11	**Bond Price**			**Formulas Used**
12	Bond price as % of par	77.18		=PRICE(B4,B5,B6,B7,B8,B9)
13	Par value	$1,000.00		
14	Bond price	$771.82		=B12%*B13
15				

We first use the =PRICE(settlement, maturity, rate, yield, redemption, frequency) formula in Excel to calculate the bond price as a percentage of par. We then multiply this percentage (77.18 percent in the above example) by $1,000 to obtain the bond price in dollars. A bond yield, which is discussed in the next section, is calculated in a similar manner, using the "=YIELD (settlement, maturity, rate, price, redemption, frequency)" formula.

Figure 8.7

$$P_B = \frac{\$50}{1.08} + \frac{\$50}{(1.08)^2} + \frac{\$1{,}050}{(1.08)^3}$$
$$= \$46.30 + \$42.87 + \$833.52$$
$$= \$922.69$$

$$P_B = \frac{C/m}{1 + i/m} + \frac{C/m}{(1 + i/m)^2} + \frac{C/m}{(1 + i/m)^3} + \cdots + \frac{C/m + F_{mn}}{(1 + i/m)^{mn}} \qquad (8.2)$$

Figure 8.8

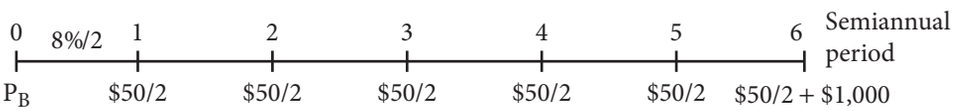


Figure 8.9

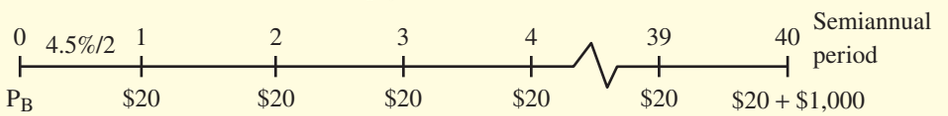
$$P_B = \frac{\$25}{1.04} + \frac{\$25}{(1.04)^2} + \frac{\$25}{(1.04)^3} + \frac{\$25}{(1.04)^4} + \frac{\$25}{(1.04)^5} + \frac{\$1{,}025}{(1.04)^6}$$
$$= \$921.37$$

LEARNING BY DOING

Application 8.2 | Bond Pricing with Semiannual Coupon Payments

Problem A corporate treasurer decides to purchase a 20-year Treasury bond with a 4 percent coupon rate. If the current market rate of interest for similar Treasury securities is 4.5 percent, what is the price of the bond?

Approach Treasury securities pay interest semiannually, so this problem is best worked on a financial calculator because of the large number of compounding periods. We can convert the bond data to semiannual compounding as follows: (1) the bond's semiannual yield is 2.25 percent (4.5 percent per year/2 = 2.25 percent), (2) the semiannual coupon payment is \$20 [(\$1,000 × 4 percent)/2 = \$40/2 = \$20], and (3) the total number of compounding periods is 40 (2 periods per year × 20 years = 40 periods). Note that at maturity, the bond principal, or face value, of \$1,000 is paid to the investor. Thus, the bond's time line for the cash payments is as follows:



Solution We can enter the appropriate values on the financial calculator and solve for the present value:

	40	2.25		20	1,000
Enter	N	i	PV	PMT	FV
Answer			**−934.52**		

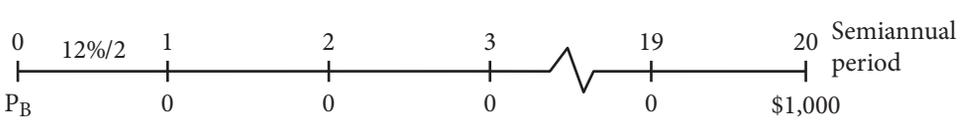
The bond sells for a discount, and its price is \$934.52.

$$P_B = \frac{F_{mn}}{(1 + i/m)^{mn}} \tag{8.3}$$

Figure 8.10

$$P_B = \frac{F_n}{(1 + i)^n}$$

Figure 8.11

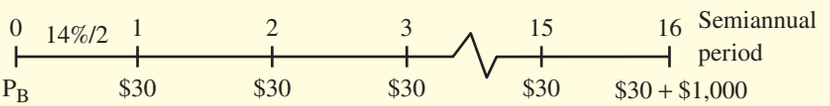


APPLICATION 8.3 | Pricing a Corporate Bond

LEARNING BY DOING

Problem An investor is considering buying a U.S. corporate bond with an eight-year maturity and a coupon rate of 6 percent. Similar bonds in the marketplace yield 14 percent. How much should the investor be willing to pay for the bond? Using Equation 8.1 (or 8.2), set up the equation to be solved, and then solve the problem using your financial calculator. Note that the discount rate used in the problem is the 14 percent market yield on similar bonds (bonds of similar risk), which is the investor's opportunity cost.

Approach Since U.S. corporate bonds pay coupon interest semiannually, we first need to convert all of the bond data to reflect semiannual compounding: (1) the annual coupon payment is \$60 per year (6 percent × \$1,000 = \$60) and the semiannual payment is \$30 per period (\$60 per year/2 = \$30); (2) he appropriate semiannual yield is 7 percent (14 percent/2 = 7 percent); and (3) the total number of compounding periods is 16 (2 periods per year × 8 years = 16 periods). The time line for the semiannual cash flows is as follows:



Solution Using Equation 8.1 (or 8.2), the setup is as follows:

$$P_B = \frac{\$30}{1.07} + \frac{\$30}{(1.07)^2} + \cdots + \frac{\$1{,}030}{(1.07)^{16}}$$

To solve the problem using a financial calculator, we enter the appropriate values and solve for PV:

Enter	16	7		30	1,000
	N	i	PV	PMT	FV
Answer			**−622.13**		

The investor should be willing to pay \$622.13 because the bond's yield at this price would be exactly 14 percent, which is the current market yield on similar bonds. If the bond price was more than \$622.13, the investment would yield a return of less than 14 percent. In this situation an investor would be better off buying the similar bonds in the market that yield 14 percent. Of course, if the investor can buy the bond for less than \$622.13, the price is a bargain, and the return on investment will be greater than the market yield.

Figure 8.12

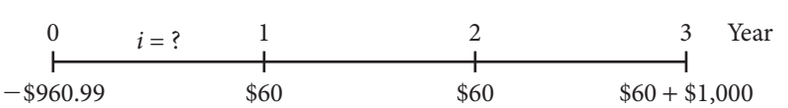


Figure 8.13

$$960.99 = \frac{\$60}{1+i} + \frac{\$60}{(1+i)^2} + \frac{\$1{,}060}{(1+i)^3}$$

Figure 8.14

$$\$973.76 = \frac{\$60}{1.07} + \frac{\$60}{(1.07)^2} + \frac{\$1{,}060}{(1.07)^3}$$

Figure 8.15

$$\$955.95 = \frac{\$60}{1.077} + \frac{\$60}{(1.077)^2} + \frac{\$1{,}060}{(1.077)^3}$$

Figure 8.16

$$\$960.99 = \frac{\$60}{1.075} + \frac{\$60}{(1.075)^2} + \frac{\$1{,}060}{(1.075)^3}$$

Figure 8.17

Enter	3		−960.99	60	1,000
	N	i	PV	PMT	FV
Answer		**7.5**			

Figure 8.18

$$\text{EAY} = \left(1 + \frac{\text{Quoted interest rate}}{m}\right)^m - 1$$

Figure 8.19

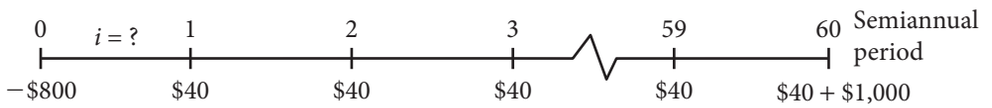


Figure 8.20

$$\$800 = \frac{\$40}{1 + i/2} + \frac{\$40}{(1 + i/2)^2} + \frac{\$40}{(1 + i/2)^3} + \cdots + \frac{\$40}{(1 + i/2)^{59}} + \frac{\$1{,}040}{(1 + i/2)^{60}}$$

Figure 8.21

Enter	60		−800	40	1,000
	N	**i**	**PV**	**PMT**	**FV**
Answer		**5.07**			

Figure 8.22

$$\begin{aligned} \text{EAY} &= \left(1 + \frac{\text{Quoted interest rate}}{m}\right)^m - 1 \\ &= \left(1 + \frac{0.1014}{2}\right)^2 - 1 \\ &= (1.0507)^2 - 1 = 0.1040, \text{ or } 10.40\% \end{aligned}$$

LEARNING BY DOING

APPLICATION 8.4 | Choosing between Bonds with Different Coupon Payment Frequencies

Problem You can purchase a U.S. corporate bond from your broker for $1,099.50. The bond has six years to maturity, and an annual coupon rate of 5 percent. Another broker offers you a dollar Eurobond (a dollar-denominated bond sold overseas) with a yield of 3.17 percent, which is denominated in U.S. dollars and has the same maturity and credit rating as the U.S. corporate bond. Which bond should you buy?

Approach Solving this problem involves two steps. First, we must compute the U.S. bond's yield to maturity. The bond pays coupon interest semiannually, so we have to convert the bond data to semiannual periods: (1) the number of compounding periods is 12 (6 years × 2 periods per year = 12 periods) and (2) the semiannual coupon payment is $25 [($1,000 × 0.05)/2 = $50/2 = $25]. Second, we must annualize the yield for the U.S. bond so that we can compare its yield with that of the Eurobond.

Solution We can solve for the yield to maturity using a financial calculator:

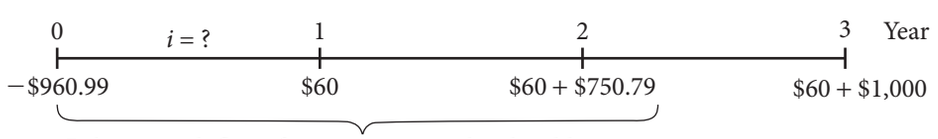
Enter	12		−1,099.50	25	1,000
	N	i	PV	PMT	FV
Answer		**1.5831**			

The answer, 1.5831 percent, is the semiannual yield. Since the Eurobond's yield, 3.17 percent, is an annualized yield because of that bond's yearly compounding, we must annualize the yield on the U.S. bond in order to compare the two. We annualize the yield on the U.S. bond by computing its effective annual yield:

$$\begin{aligned} \text{EAY} &= \left(1 + \frac{\text{Quoted interest rate}}{m}\right)^m - 1 \\ &= \left(1 + \frac{0.031662}{2}\right)^2 - 1 \\ &= (1.015831)^2 - 1 = 0.03191, \text{or } 3.191\% \end{aligned}$$

The U.S. corporate bond is a better deal because of its higher EAY (3.191 percent > 3.170 percent). Notice that if we had just annualized the yield on the U.S. bond by multiplying the semiannual yield by 2 (1.5831 percent × 2 = 3.1661 percent) and compared the simple yields for the Eurobond and the U.S. bond (3.170 percent > 3.1661 percent), we would have selected the Eurobond. This would have been the wrong economic decision.

Figure 8.23



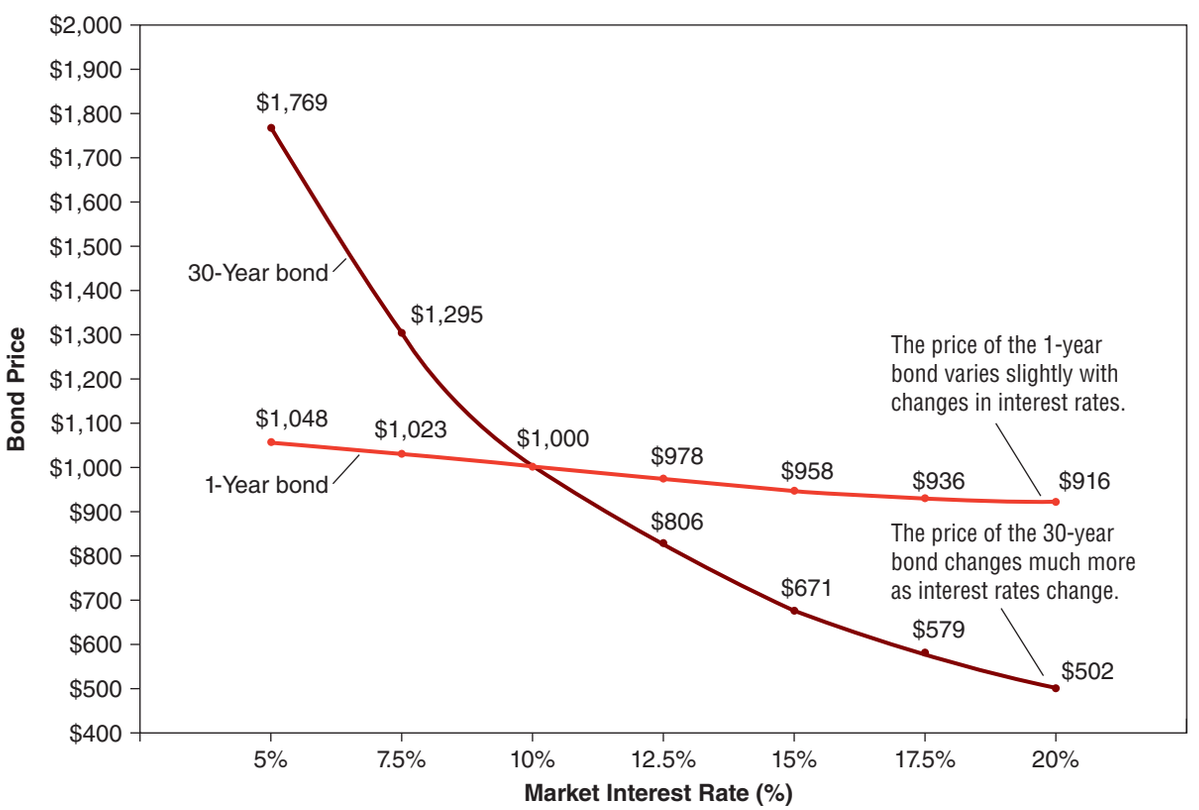
Relevant cash flows for computing realized yield

Figure 8.24

$$P_B = \$960.99 = \frac{\$60}{1+i} + \frac{\$60}{(1+i)^2} + \frac{\$750.79}{(1+i)^2}$$

Figure 8.25

Enter	2		−960.99	60	750.79
	N	i	PV	PMT	FV
Answer		**−4.97**			



Note: Plots are for a 1-year bond and a 30-year bond with a 10 percent coupon rate and annual payment

EXHIBIT 8.2 **Relation between Bond Price Volatility and Maturity**

The prices of a 1-year and a 30-year bond respond differently to changes in market interest rates. The long-term bond has much wider price swings than the short-term bond, as predicted by the second bond theorem.

EXHIBIT 8.3 **Relation between Bond Price Volatility and the Coupon Rate**

The exhibit shows the prices of three 10-year bonds: a zero coupon bond, a 5 percent coupon bond, and a 10 percent coupon bond. Initially, the bonds are priced at a 5 percent yield (column 2). The bonds are then priced at yields of 6 and 4 percent (columns 3 and 6). The price changes shown are consistent with the third bond theorem: the smaller the coupon rate, the greater the percentage price change for a given change in interest rates.

		Price Change If Yield Increases from 5% to 6%			Price Change If Yield Decreases from 5% to 4%		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Coupon Rate	Bond Price at 5% Yield	Bond Price at 6%	Loss from Increase in Yield	% Price Change	Bond Price at 4%	Gain from Decrease in Yield	% Price Change
0%	$ 613.91	$ 588.39	$25.52	−9.04%	$ 675.56	$61.65	10.04%
5%	$1,000.00	$ 926.40	$73.60	−7.36%	$1,081.11	$81.11	8.11%
10%	$1,386.09	$1,294.40	$91.69	−6.62%	$1,486.65	$100.56	7.25%

Note: Calculations are based on a bond with a $1,000 face value and a 10-year maturity and assume annual compounding.

DECISION MAKING

EXAMPLE 8.1 | Risk Taking

Situation You work for the treasurer of a large manufacturing corporation where earnings are down substantially for the year. The treasurer's staff is convinced that interest rates are going to decline over the next three months, and they want to invest in fixed-income securities to make as much money as possible for the firm. The staff recommends investing in one of the following securities:

- 3-month Treasury bill
- 20-year corporate bond
- 20-year zero coupon Treasury bond

The treasurer asks you to answer the following questions about the staff's plan: (1) What is the underlying strategy of the proposed plan? (2) Which investment should be selected if the plan were to be executed? (3) What should the treasurer do?

Decision First, the staff's strategy is based on the negative relation between interest rates and bond prices. Thus, if interest rates decline, bond prices will rise, and the firm will earn a capital gain. Second, to maximize earnings, the treasurer should select bonds that will have the largest price swing for a given change in interest rates. Bond theorems 2 and 3 suggest that for a given change in interest rates, low-coupon, long-term bonds will have the largest price swing. Thus, the treasurer should invest in the 20-year zero coupon Treasury bond. With respect to the plan's merits, the intentions are good, but the investment plan is pure folly. Generating "earnings" from risky financial investments is not the firm's line of business or one of its core competencies. As was discussed in Chapter 1, the treasurer's primary investment function is to invest idle cash in safe investments such as money market instruments that have very low default and interest rate risk.

Figure 8.26

$$\text{MRP} = i_{\text{low mkt}} - i_{\text{high mkt}} > 0$$

Figure 8.27

$$\text{CIP} = i_{\text{call}} - i_{\text{ncall}} > 0$$

Figure 8.28

$$\text{DRP} = i_{\text{dr}} - i_{\text{rf}} > 0$$

EXHIBIT 8.4 **Corporate Bond Rating Systems**

Moody's has a slightly different notation in its ratings of corporate bonds than do Standard & Poor's and Fitch, but the interpretation is the same. Bonds with the highest credit standing are rated Aaa (or AAA) and have the lowest default risk. The credit rating declines as the default risk of the bonds increases.

Explanation	Moody's	Standard & Poor's/Fitch	Default Risk Premium	Regulatory Designation
Best quality, smallest degree of risk	Aaa	AAA	Lowest	Investment Grade
High quality, slightly more long-term risk than top rating	Aa	AA	↓	↓
Upper-medium grade, possible impairment in the future	A	A		
Medium grade, lacks outstanding investment characteristics	Baa	BBB		
Speculative, protection may be very moderate	Ba	BB		Noninvestment Grade
Very speculative, may have small assurance of interest and principal payments	B	B		↓
Issues in poor standing, may be in default	Caa	CCC		
Speculative to a high degree, with marked shortcomings	Ca	CC	↓	
Lowest quality, poor prospects of attaining real investment standing	C	C	Highest	↓

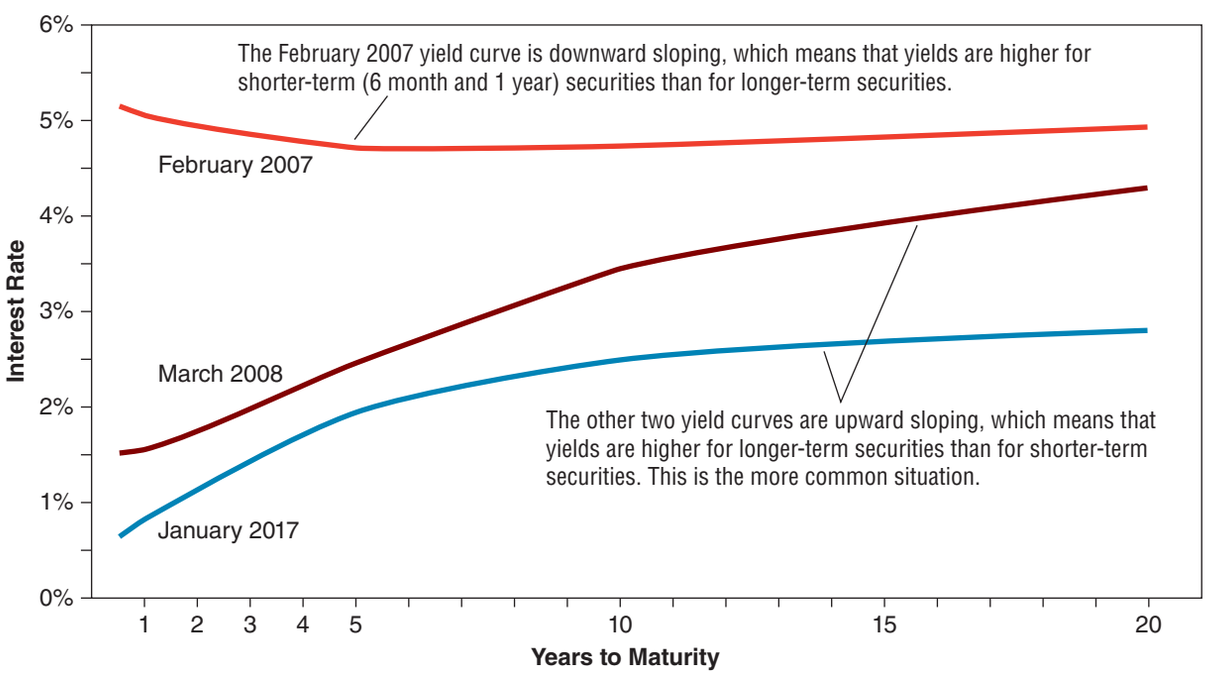
EXHIBIT 8.5 **Default Risk Premiums for Selected Bond Ratings**

The default risk premium (DRP) measures the yield difference between the yield on Treasury securities (the risk-free rate) and the yields on riskier securities of the same maturity.

Security: Credit Rating	Security Yield (%) (1)	Risk-Free Rate[a] (%) (2)	Default Risk: Premium (%) (1) – (2)
Aaa/AAA	3.77	2.79	0.98
Aa/AA	3.87	2.79	1.08
A/A	4.41	2.79	1.62
Baa/BBB	6.29	2.79	3.50

[a]20-year Treasury bond yield as of January 27, 2017.

Sources: U.S. Department of the Treasury (https://www.treasury.gov/resource-center/data-chart-center/interest-rates/Pages/TextView.aspx?data=yield) and Fidelity (https://fi xedincome.fi delity.com/ftgw/fi /FILanding).



Terms to Maturity	Interest Rate (%) January 2017	March 2008	February 2007
6 months	0.63	1.51	5.16
1 year	0.82	1.55	5.06
5 year	1.94	2.46	4.72
10 years	2.49	3.45	4.74
20 years	2.80	4.30	4.94

EXHIBIT 8.6 **Yield Curves for Treasury Securities at Three Different Points in Time**

The shape, or slope, of the yield curve is not constant over time. The exhibit shows two shapes: (1) the curves for March 2008 and January 2017 are upward sloping, which is the shape most commonly observed, and (2) the curve for February 2007 is downward sloping for maturities out to seven years.

Summary of Key Equations

Equation	Description	Formula
8.1	Price of a bond	$P_B = \frac{C_1}{1+i} + \frac{C_2}{(1+i)^2} + \cdots + \frac{C_n + F_n}{(1+i)^n}$
8.2	Price of a bond making multiple payments each year	$P_B = \frac{C/m}{1+i/m} + \frac{C/m}{(1+i/m)^2} + \frac{C/m}{(1+i/m)^3} + \cdots + \frac{C/m + F_{mn}}{(1+i/m)^{mn}}$
8.3	Price of zero coupon bond	$P_B = \frac{F_{mn}}{(1+i/m)^{mn}}$

Self-Study Problems

8.1 Calculate the price of a five-year bond that has a coupon rate of 6.5 percent paid annually. The current market rate is 5.75 percent.

8.2 Bigbie Corp. issued a five-year bond one year ago with a coupon rate of 8 percent. The bond pays interest semiannually. If the yield to maturity on this bond is 9 percent, what is the price of the bond?

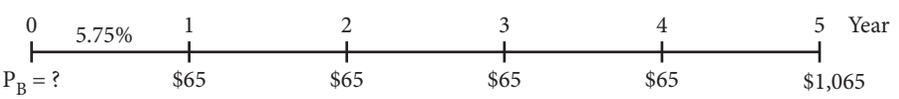
8.3 Rockwell Industries has a three-year bond outstanding that pays a 7.25 percent coupon rate and is currently priced at $913.88. What is the yield to maturity of this bond? Assume annual coupon payments.

8.4 Hindenberg, Inc., has a 10-year bond that is priced at $1,100.00. It has a coupon rate of 8 percent paid semiannually. What is the yield to maturity on this bond?

8.5 Highland Corp., a U.S. company, has a five-year bond whose yield to maturity is 6.5 percent. The bond has no coupon payments. What is the price of this zero coupon bond?

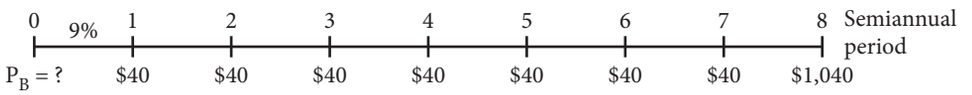
Solutions to Self-Study Problems

8.1 The time line and calculations for the five-year bond are as follows:



$$
\begin{aligned}
P_B &= \frac{C_1}{1+i} + \frac{C_2}{(1+i)^2} + \frac{C_3}{(1+i)^3} + \frac{C_4}{(1+i)^4} + \frac{C_5 + F_5}{(1+i)^5} \\
&= \frac{\$65}{1.0575} + \frac{\$65}{(1.0575)^2} + \frac{\$65}{(1.0575)^3} + \frac{\$65}{(1.0575)^4} + \frac{\$65 + \$1{,}000}{(1.0575)^5} \\
&= \$61.47 + \$58.12 + \$54.96 + \$51.95 + \$805.28 \\
&= \$1{,}031.81
\end{aligned}
$$

8.2 We can find the price of Bigbie Corp.'s bond as follows:



$$P_B = \frac{C/m}{1 + i/m} + \frac{C/m}{(1 + i/m)^2} + \frac{C/m}{(1 + i/m)^3} + \cdots + \frac{C/m + F_8}{(1 + i/m)^8}$$

$$= \frac{\$40}{1.045} + \frac{\$40}{(1.045)^2} + \frac{\$40}{(1.045)^3} + \cdots + \frac{(\$40 + \$1{,}000)}{(1.045)^8}$$

$$= \$38.28 + \$36.63 + \$35.05 + \$33.54 + \$32.10 + \$30.72 + \$29.39 + \$731.31$$

$$= \$967.02$$

Alternatively, we can use the present value of an ordinary annuity equation (Equation 6.1 from Chapter 6) and the present value equation (Equation 5.4 from Chapter 5) to solve for the price of the bond.

$$P_B = C \times \left[\frac{1 - \frac{1}{(1 + i/m)^{mn}}}{i/m}\right] + \frac{F_n}{(1 + i/m)^{mn}} = \$40 \times \left[\frac{1 - \frac{1}{(1 + 0.045)^8}}{0.045}\right] + \frac{\$1{,}000}{(1.045)^8}$$

$$= \$263.84 + \$703.19 = \$967.03$$

8.3 We start with a time line for Rockwell's bond:

Use trial and error to solve for the yield to maturity (YTM). Since the bond is selling at a discount, we know that the yield to maturity is higher than the coupon rate.

Try YTM = 10%.

$$P_B = \frac{C_1}{1 + i} + \frac{C_2}{(1 + i)^2} + \frac{C_3 + F_3}{(1 + i)^3}$$

$$\$913.88 = \frac{\$72.50}{1.10} + \frac{\$72.50}{(1.10)^2} + \frac{\$72.50 + \$1{,}000}{(1.10)^3}$$

$$= \$65.91 + \$59.92 + \$805.79$$

$$\neq \$931.61$$

Try a higher rate, say YTM = 11%.

$$P_B = \frac{C_1}{1 + i} + \frac{C_2}{(1 + i)^2} + \frac{C_3 + F_3}{(1 + i)^3}$$

$$\$913.88 = \frac{\$72.50}{1.11} + \frac{\$72.50}{(1.11)^2} + \frac{\$72.50 + \$1{,}000}{(1.11)^3}$$

$$= \$65.32 + \$58.84 + \$784.20$$

$$\neq \$908.36$$

Since this is less than the price of the bond, we know that the YTM is between 10 and 11 percent and closer to 11 percent.

Try YTM = 10.75%.

$$P_B = \frac{C_1}{1 + i} + \frac{C_2}{(1 + i)^2} + \frac{C_3 + F_3}{(1 + i)^3}$$

$$\$913.88 = \frac{\$72.50}{1.1075} + \frac{\$72.50}{(1.1075)^2} + \frac{\$72.50 + \$1{,}000}{(1.1075)^3}$$

$$= \$65.46 + \$59.11 + \$789.53$$

$$\cong \$914.09$$

Alternatively, we can use Equation 6.1 and Equation 5.4 to solve for the price of the bond.

$$P_B = C \times \left[\frac{1 - \frac{1}{(1+i)^n}}{i}\right] + \frac{F_n}{(1+i)^n}$$

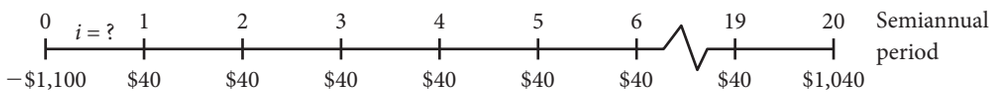
$$\$913.88 = \$72.50 \times \left[\frac{1 - \frac{1}{(1+0.1075)^3}}{0.1075}\right] + \frac{\$1{,}000}{(1.1075)^3}$$

$$= \$177.94 + \$736.15$$

$$\cong \$914.09$$

Thus, the YTM is approximately 10.75 percent. Using a financial calculator provides an exact YTM of 10.7594%.

8.4 The time line for Hindenberg's 10-year bond looks like this:



The easiest way to calculate the yield to maturity is with a financial calculator. The inputs are as follows:

Enter	20		−1,100	40	1,000
	N	i	PV	PMT	FV
Answer		**3.31**			

The answer we get is 3.31 percent, which is the semiannual interest rate. To obtain an annualized yield to maturity, we multiply this by two:

$$YTM = 3.31\% \times 2$$

$$YTM = 6.62\%$$

8.5 You have the following information about Highland's bonds:

$$YTM = 6.5\%$$

No coupon payments

Most U.S. bonds pay interest semiannually. Thus $m \times n = 2 \times 5 = 10$ and $i/2 = 0.065/2 = 0.0325$. Using Equation 8.3, we obtain the following:

$$P_B = \frac{F_{mn}}{(1 + i/m)^{mn}}$$

$$= \frac{\$1{,}000}{(1 + 0.0325)^{10}}$$

$$= \$726.27$$

Discussion Questions

8.1 Because the conversion feature in a convertible bond is valuable to bondholders, convertible bond issues have lower coupon payments than otherwise similar bonds that are not convertible. Does this mean that a company can lower its cost of borrowing by selling convertible debt? Explain.

8.2 What economic conditions would prompt investors to take advantage of a bond's convertibility feature?

8.3 We know that a vanilla bond with a coupon rate below the market rate of interest will sell for a discount and that a vanilla bond with a coupon rate above the market rate of interest will sell for a premium. What kind of bond or loan will sell at its par value regardless of what happens to the market rate of interest?

8.4 Define *yield to maturity*. Why is it important?

8.5 Define *interest rate risk*. How can CFOs manage this risk?

8.6 Explain why bond prices and interest rates are negatively related. What are the roles of the coupon rate and the term to maturity in this relation?

8.7 If interest rates are expected to increase, should investors look to long-term bonds or short-term bonds? Explain.

8.8 Explain what you would assume the yield curve would look like during economic expansion and why.

8.9 An investor holds a 10-year bond paying a coupon rate of 9 percent. The yield to maturity of the bond is 7.8 percent. Would you expect the investor to be holding a par-value, premium, or discount bond? What if the yield to maturity were 10.2 percent? Explain.

8.10 **a.** Investor A holds a 10-year bond, while investor B holds an 8-year bond. If the interest rate increases by 1 percent, which investor has the higher interest rate risk? Explain.

b. Investor A holds a 10-year bond paying 8 percent a year, while investor B also has a 10-year bond that pays a 6 percent coupon. Which investor has the higher interest rate risk? Explain.

Questions and Problems

Basic

8.1 **Bond price:** BA Corp is issuing a 10-year bond with a coupon rate of 8 percent. The interest rate for similar bonds is currently 6 percent. Assuming annual payments, what is the value of the bond?

8.2 **Bond price:** Pierre Dupont just received a cash gift from his grandfather. He plans to invest in a five-year bond issued by Venice Corp. that pays an annual coupon rate of 5.5 percent. If the current market rate is 7.25 percent, what is the maximum amount Pierre should be willing to pay for this bond?

8.3 **Bond price:** Knight, Inc., has issued a three-year bond that pays a coupon rate of 6.10 percent. Coupon payments are made semiannually. Given the market rate of interest of 5.80 percent, what is the market value of the bond?

8.4 **Bond price:** Regatta Inc. has seven-year bonds outstanding that pay a 12 percent coupon rate. Investors buying these bonds today can expect to earn a yield to maturity of 8.875 percent. What is the current value of these bonds? Assume annual coupon payments.

8.5 **Bond price:** You are interested in investing in a five-year bond that pays a 7.8 percent coupon rate with interest to be received semiannually. Your required rate of return is 8.4 percent. What is the most you would be willing to pay for this bond?

8.6 **Zero coupon bonds:** Diane Carter is interested in buying a five-year zero coupon bond with a face value of $1,000. She understands that the market interest rate for similar investments is 9 percent. Assume annual coupon payments. What is the current value of this bond?

8.7 **Zero coupon bonds:** Ten-year zero coupon bonds issued by the U.S. Treasury have a face value of $1,000 and interest is compounded semiannually. If similar bonds in the market yield 10.5 percent, what is the value of these bonds?

8.8 **Zero coupon bonds:** Northrop Real Estate Company management is planning to fund a development project by issuing 10-year zero coupon bonds with a face value of $1,000. Assuming semiannual compounding, what will be the price of these bonds if the appropriate discount rate is 14 percent?

8.9 **Yield to maturity:** Ruth Hornsby is looking to invest in a three-year bond that makes semi-annual coupon payments at a rate of 5.875 percent. If these bonds have a market price of $981.13, what yield to maturity can she expect to earn?

8.10 **Yield to maturity:** Rudy Sandberg wants to invest in four-year bonds that are currently priced at $868.43. These bonds have a coupon rate of 6 percent and make semiannual coupon payments. What is the current market yield on this bond?

8.11 **Realized yield:** Josh Kavern bought 10-year, 12 percent coupon bonds issued by the U.S. Treasury three years ago at $913.44. If he sells these bonds, for which he paid the face value of $1,000, at the current price of $804.59, what is his realized yield on the bonds? Assume similar coupon-paying bonds make annual coupon payments.

8.12 **Realized yield:** Four years ago, Lisa Stills bought six-year, 5.5 percent coupon bonds issued by the Fairways Corp. for $947.68. If she sells these bonds at the current price of $894.52, what will be her realized yield on the bonds? Assume similar coupon-paying bonds make annual coupon payments.

Intermediate

8.13 Bond price: The International Publishing Group is raising $10 million by issuing 15-year bonds with a coupon rate of 8.5 percent. Coupon payments will be made annually. Investors buying the bonds today will earn a yield to maturity of 8.5 percent. At what price will the bonds sell in the marketplace? Explain.

8.14 Bond price: Lopez Information Systems management is planning to issue 10-year bonds. The going market yield for such bonds is 8.125 percent. Assume that coupon payments will be made semiannually. Management is trying to decide between issuing an 8 percent coupon bond or a zero coupon bond. Lopez needs to raise $1 million. What will be the price of an 8 percent coupon bond, and how many 8 percent coupon bonds will have to be issued? What will be the price of a zero coupon bond, and how many zero coupon bonds will have to be issued?

8.15 Bond price: Marshall Company is issuing eight-year bonds with a coupon rate of 6.5 percent and semiannual coupon payments. If the current market rate for similar bonds is 8 percent, what will the bond price be? If company management wants to raise $1.25 million, how many bonds does the firm have to sell?

8.16 Bond price: Rockne, Inc., has outstanding bonds that will mature in six years and pay an 8 percent coupon semiannually. If you paid $1,036.65 today and your required rate of return was 6.6 percent, did you pay the right price for the bond?

8.17 Bond price: Nanotech, Inc., has a bond issue maturing in seven years that is paying a coupon rate of 9.5 percent (semiannual payments). Management wants to retire a portion of the issue by buying the securities in the open market. If it can refinance at 8 percent, how much will Nanotech pay to buy back its current outstanding bonds?

8.18 Zero coupon bonds: Kintel, Inc., management wants to raise $1 million by issuing six-year zero coupon bonds with a face value of $1,000. The company's investment banker states that investors would use an 11.4 percent discount rate to value such bonds. At what price would these bonds sell in the marketplace? How many bonds would the firm have to issue to raise $1 million? Assume semiannual coupon payments.

8.19 Zero coupon bonds: Rockinghouse Corp. management plans to issue seven-year zero coupon bonds. It has learned that these bonds will sell today at a price of $439.76. Assuming annual coupon payments, what is the yield to maturity on these bonds?

8.20 Yield to maturity: Electrolex, Inc., has four-year bonds outstanding that pay a coupon rate of 6.6 percent and make coupon payments semiannually. If these bonds are currently selling at $914.89, what is the yield to maturity that an investor can expect to earn on these bonds? What is the effective annual yield?

8.21 Yield to maturity: Serengeti Corp. has five-year bonds outstanding that pay a coupon rate of 8.8 percent. If these bonds are priced at $1,064.86, what is the yield to maturity on these bonds? Assume semiannual coupon payments. What is the effective annual yield?

8.22 Yield to maturity: Adrienne Dawson is planning to buy 10-year zero coupon bonds issued by the U.S. Treasury. If these bonds have a face value of $1,000 and are currently selling at $404.59, what is the expected return on them? Assume that interest compounds semiannually on similar coupon paying bonds.

8.23 Realized yield: Brown & Co. issued seven-year bonds two years ago that can be called after two years. The bonds make semiannual coupon payments at a coupon rate of 7.875 percent. Each bond has a market value of $1,053.40, and the call price is $1,078.75. If an investor purchased the bonds at par value when they were originally issued and the bonds are called by the firm today, what is the investor's realized yield?

8.24 Realized yield: Trevor Price bought 10-year bonds issued by Harvest Foods five years ago for $936.05. The bonds make semiannual coupon payments at a rate of 8.4 percent. If the current price of the bonds is $1,048.77, what is the yield that Trevor would earn by selling the bonds today?

8.25 Realized yield: You bought a six-year bond issued by Runaway Corp. four years ago. At that time, you paid $974.33 for the bond. The bond pays a coupon rate of 7.375 percent, and coupon payments are made semiannually. Currently, the bond is priced at $1,023.56. What yield can you expect to earn on this bond if you sell it today?

Advanced

8.26 Pullman Corp issued 10-year bonds four years ago with a coupon rate of 9.375 percent. At the time of issue, the bonds sold at par. Today bonds of similar risk and maturity must pay an annual coupon of 6.25 percent to sell at par value. Assuming semiannual coupon payments:

- **a.** What is the bond's yield to maturity?
- **b.** What is the current market price of the firm's bonds?

8.27 Showbiz, Inc., has issued eight-year bonds with a coupon rate of 6.375 percent and semiannual coupon payments. The market's required rate of return on such bonds is 7.65 percent.

- **a.** What is the market price of these bonds?
- **b.** If the above bond is callable after five years at an 8.5 percent premium on the face value, what is the expected return on this bond?

8.28 Peabody Corp. has seven-year bonds outstanding. The bonds pay a coupon rate of 8.375 percent semiannually and are currently worth $1,063.49. The bonds can be called in three years at a price of $1,075.

- **a.** What is the yield to maturity of these bonds?
- **b.** What is the effective annual yield?
- **c.** What is the realized yield on the bonds if they are called?
- **d.** If you plan to invest in one of these bonds today, what is the expected yield on the investment? Explain.

8.29 The Maryland Department of Transportation has issued 25-year bonds that make semiannual coupon payments at a rate of 9.875 percent. The current market rate for similar securities is 11 percent.

- **a.** What is the current market value of one of these bonds?
- **b.** What will be the bond's price if rates in the market (i) decrease to 9 percent or (ii) increase to 12 percent?

c. Refer to your answers in part b. How do the interest rate changes affect premium bonds and discount bonds?

d. Suppose the bond were to mature in 12 years. How do the interest rate changes in part b affect the bond prices?

8.30 Rachette Corp. has 18-year bonds outstanding. These bonds, which pay interest semiannually, have a coupon rate of 9.735 percent and a yield to maturity of 7.95 percent.

a. Compute the current price of these bonds.

b. If the bonds can be called in five years at a premium of 13.5 percent over par value, what is the investor's realized yield?

c. If you bought one of these bonds today, what is your expected rate of return? Explain.

8.31 Zippy Corporation just sold $30 million of convertible bonds with a conversion ratio of 40. Each $1,000 bond is convertible into 25 shares of Zippy's stock.

a. What is the conversion price of Zippy's stock?

b. If the current price of Zippy's stock is $15 and the company's annual stock return is normally distributed with a standard deviation of $5, what is the probability that investors will find it attractive to convert the bond into Zippy stock in the next year?

Sample Test Problems

8.1 Seven years ago Eastern Corporation issued 20-year bonds that had a $1,000 face value, paid interest annually, and had a coupon rate of 7 percent. If the market rate of interest is 5.5 percent today, what is the current market price of an Eastern Corporation bond? Are these bonds selling at a premium or discount?

8.2 You are considering investing in a 10-year zero coupon bond that compounds interest semiannually. If the current market rate is 5.65 percent, what is the maximum price you should have to pay for this bond?

8.3 Bigbox, Inc., has bonds outstanding that will mature in eight years. These bonds pay interest semiannually and have a coupon rate of 4.6 percent. If the bonds are currently selling at $888.92, what is the yield to maturity that an investor who buys them today can expect to earn? What is the effective annual yield?

8.4 Given a change in market interest rates, which will change more: the market price of a bond with 20 years until maturity or the market price of a bond with five years until maturity? Assume all the characteristics of these bonds are identical except the maturity dates.

8.5 Which of the following classes of securities is likely to have the lowest corporate borrowing cost?

a. AAA rated bonds.

b. A rated bonds.

c. BB rated bonds.

d. C rated bonds.

e. All of the above will have the same corporate borrowing cost.

EXHIBIT 9.1 NYSE Stock Listings from the *Wall Street Journal*

Company Name (1)	Symbol (2)	Open (3)	High (4)	Low (5)	Close (6)	Net Chg (7)
Acme United	ACU	25.76	26.20	24.77	24.77	−0.62
ACRE Realty Investors	AIII	1.13	1.13	1.08	1.08	−0.06
Actinium Pharmaceuticals	ATNM	1.31	1.35	1.20	1.35	0.02
Adams Resources & Energy	AE	39.75	39.77	37.53	37.53	−2.12
AdCare Health Systems	ADK	1.35	1.35	1.21	1.24	−0.04
AeroCentury	ACY	9.95	9.95	9.60	9.65	−0.33
Air Industries Group	AIRI	3.67	3.85	3.62	3.85	0.13
Alexco Resource	AXU	1.47	1.57	1.47	1.55	0.05
Almaden Minerals	AAU	1.07	1.12	1.05	1.10	0.04
Alpha Pro Tech	APT	3.20	3.25	3.10	3.15	. . .
Altisource Asset Management	AAMC	79.05	85.90	78.75	85.90	6.90
AMCON Distributing	DIT	101.25	102.13	98.60	99.03	−1.02
American DG Energy	ADGE	0.32	0.34	0.32	0.34	0.01

SOURCE: Wall Street Journal Online, Monday, March 6, 2017.

% Chg (8)	Volume (9)	52 Wk High (10)	52 Wk Low (11)	Div (12)	Yield (13)	P/E (14)	YTD % Chg (15)
−2.44	8,346	27.35	15.01	0.40	1.61	15.29	−3.13
−5.26	13,732	1.85	0.90	. . .	. . .	. . . dd	−2.70
1.50	1,230,368	2.36	0.86	. . .	. . .	. . . dd	54.29
−5.35	4,279	44.27	29.64	0.88	2.34	. . . dd	−5.35
−3.13	58,362	2.70	1.21	0.24	19.35	. . . dd	−15.07
−3.30	16,627	14.33	8.50	. . .	. . .	3.45	2.12
3.49	63,547	6.79	2.21	0.60	15.58	. . . dd	22.22
3.33	532,194	2.54	0.67	. . .	. . .	. . . dd	14.81
3.77	211,357	1.88	0.65	. . .	. . .	. . . dd	13.54
. . .	21,874	3.80	1.62	. . .	. . .	19.69	−10.00
8.73	20,256	85.90	11.40	. . .	. . .	. . . dd	60.56
−1.02	12,261	122.90	77.76	0.72	0.73	12.27	−14.12
1.61	14,314	0.65	0.22	. . .	. . .	. . . dd	19.75

Figure 9.1

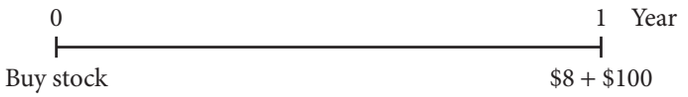


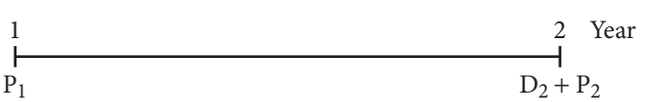
Figure 9.2

$$\begin{aligned}\text{PV(stock)} &= \text{PV(dividend)} + \text{PV(sale price)} \\ &= \frac{\$8}{1+0.2} + \frac{\$100}{1+0.2} \\ &= \frac{\$8+\$100}{1.2} = \frac{\$108}{1.2} \\ &= \$90\end{aligned}$$

Figure 9.3

$$P_0 = \frac{D_1 + P_1}{1 + R}$$

Figure 9.4



$$P_1 = \frac{D_2 + P_2}{1 + R}$$

Figure 9.5

$$P_2 = \frac{D_3 + P_3}{1 + R}$$

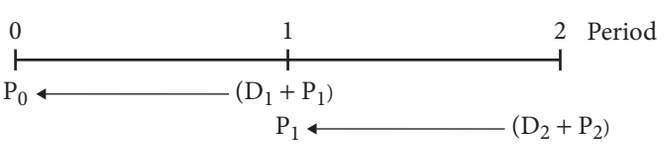
Figure 9.6

$$P_3 = \frac{D_4 + P_4}{1 + R}$$

A Perpetuity Model

Unfortunately, although our one-period model is correct, it is not very realistic. We need a stock-valuation formula for a perpetuity, not for one or two periods. However, we can string together a series of one-period stock pricing models to arrive at a stock perpetuity model. Here is how we do it.

First, we construct a two-period stock-valuation model. The time line for the two-period model is:



To construct our two-period model, we start with our initial single-period valuation model:

$$P_0 = \frac{D_1 + P_1}{1 + R}$$

Now we substitute into this equation the expression derived earlier for P_1 [$P_1 = (D_2 + P_2)/(1 + R)$] and obtain the following:

$$P_0 = \frac{D_1 + [(D_2 + P_2)/(1 + R)]}{1 + R}$$

Rearranging this equation results in a stock-valuation model for two periods:

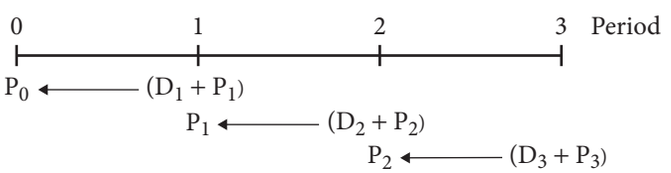
$$P_0 = \frac{D_1}{1 + R} + \frac{D_2}{(1 + R)^2} + \frac{P_2}{(1 + R)^2}$$

Finally, we combine the second-period terms to obtain:

$$P_0 = \frac{D_1}{1 + R} + \frac{D_2 + P_2}{(1 + R)^2}$$

This equation shows that the price of a share of stock that is held for two periods is the present value of the dividend in period 1 (D_1) plus the present value of the dividend and sale price in period 2 (D_2 and P_2).

Now let's construct a three-period model. The time line for the three-period model is:



If we substitute the equation for P_2 into the two-period valuation model shown above, we have a three-period model, which is as follows. Recall that $P_2 = (D_3 + P_3)/(1 + R)$.

$$\begin{aligned} P_0 &= \frac{D_1}{1 + R} + \frac{D_2}{(1 + R)^2} + \frac{P_2}{(1 + R)^2} \\ &= \frac{D_1}{1 + R} + \frac{D_2}{(1 + R)^2} + \frac{(D_3 + P_3)/(1 + R)}{(1 + R)^2} \\ &= \frac{D_1}{1 + R} + \frac{D_2}{(1 + R)^2} + \frac{D_3}{(1 + R)^3} + \frac{P_3}{(1 + R)^3} \\ &= \frac{D_1}{1 + R} + \frac{D_2}{(1 + R)^2} + \frac{D_3 + P_3}{(1 + R)^3} \end{aligned}$$

By now, it should be clear that we could go on to develop a four-period model, a five-period model, a six-period model, and so on, ad infinitum. The ultimate result is the following equation:

$$P_0 = \frac{D_1}{1 + R} + \frac{D_2}{(1 + R)^2} + \frac{D_3}{(1 + R)^3} + \cdots + \frac{D_t}{(1 + R)^t} + \frac{P_t}{(1 + R)^t}$$

Here, t is the time period, which can be any number from one to infinity (∞). We will use t, instead of n, to denote the time period from this point forward because it is more commonly used in pricing equations; n will still be used to denote the number of periods.

In summary, we have developed a model showing that the value, or price, of a share of stock today (P_0) is the present value of all future dividends and the stock's sale price in the future. Although theoretically sound, this model is not practical to apply because the number of dividends could be infinite. It is unlikely that we can successfully forecast an infinite number of dividend payments or a stock's sale price far into the future. What we need are some realistic simplifing assumptions.

$$P_0 = \frac{D_1}{1+R} + \frac{D_2}{(1+R)^2} + \frac{D_3}{(1+R)^3} + \frac{D_4}{(1+R)^4} + \frac{D_5}{(1+R)^5} + \cdots + \frac{D_\infty}{(1+R)^\infty}$$
$$= \sum_{t=1}^{\infty} \frac{D_t}{(1+R)^t} \qquad (9.1)$$

Figure 9.7

$$P_0 = \frac{0}{1+R} + \frac{0}{(1+R)^2} + \frac{0}{(1+R)^3} + \cdots = 0$$

Figure 9.8

$$P_0 = \frac{D}{1+R} + \frac{D}{(1+R)^2} + \frac{D}{(1+R)^3} + \frac{D}{(1+R)^4} + \frac{D}{(1+R)^5} + \cdots + \frac{D}{(1+R)^\infty}$$

$$P_0 = \frac{D}{R} \qquad (9.2)$$

Figure 9.9

$$P_0 = \frac{D}{R} = \frac{\$5}{0.20} = \$25 \text{ per share}$$

LEARNING BY DOING

APPLICATION 9.1 | The Value of a Small Business

Problem For the past 15 years, a family has operated the gift shop in a luxury hotel near Rodeo Drive in Los Angeles. The hotel management wants to sell the gift shop to the family members rather than paying them to operate it. The family's accountant will incorporate the new business and estimates that it will generate an annual cash dividend of $150,000 for the stockholders. The hotel will provide the family with an infinite guarantee for use of the space and a generous buyout plan in the unlikely event that the hotel closes its doors. The accountant estimates that a 20 percent discount rate is appropriate. What is the value of the stock?

Approach Assuming that the business will operate indefinitely, that its growth is constrained by its circumstances, and that inflation will be negligible, the zero-growth discount model can be used to value the stock. Thus, we can use Equation 9.2. Since the number of shares outstanding is not known, we can simply interpret P_0 as being the total value of the outstanding stock.

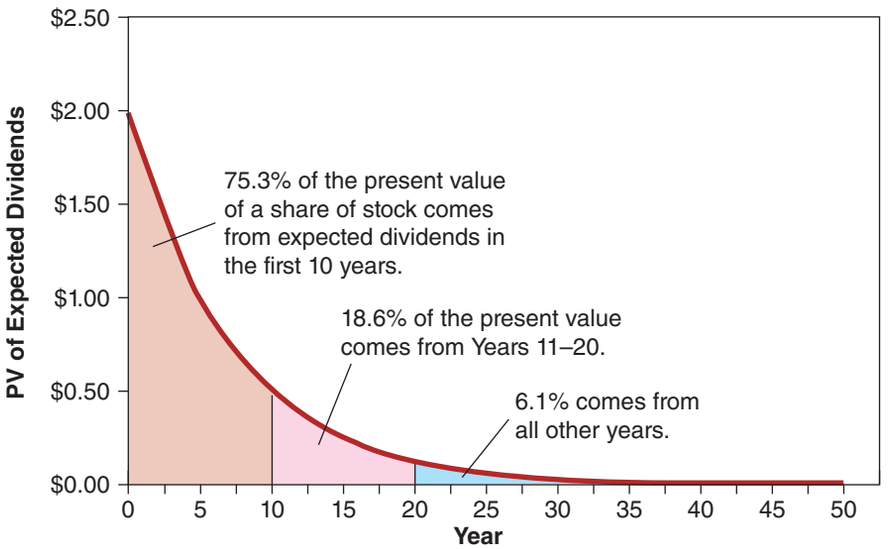
Solution Applying Equation 9.2:

$$P_0 = \frac{D}{R} = \frac{\$150{,}000}{0.20} = \$750{,}000$$

Figure 9.10

$$FV_n = PV \times (1 + i)^n$$

$$D_t = D_0 \times (1 \times g)^t \qquad (9.3)$$



Note: Calculations based on discount rate of 15% and constant dividends.

EXHIBIT 9.2 **Impact on Stock Prices of Near and Distant Future Dividends**

Dividends expected far in the future have a smaller present value than dividends expected in the next few years, and so they have less effect on the price of the stock. As you can see in the exhibit, with constant dividends more than 75 percent of the current price of a share of stock comes from expected dividends in the first 10 years.

Figure 9.11

$$\text{PVP} = \frac{\text{CF}_1}{i - g}$$

$$P_0 = \frac{D_1}{R - g} \qquad (9.4)$$

Figure 9.12

$$D_1 = D_0 \times (1 + g) = \$4.81 \times (1 + 0.04) = \$4.81 \times 1.04 = \$5.00$$

Figure 9.13

$$\begin{aligned} P_0 &= \frac{D_1}{R - g} \\ &= \frac{\$5.00}{0.18 - 0.04} \\ &= \frac{\$5.00}{0.14} \\ &= \$35.71 \end{aligned}$$

LEARNING BY DOING

APPLICATION 9.2 | Big Red Grows Faster

Problem Using the information given in the text, compute the value of Big Red's stock if dividends grow at 6 percent rather than 4 percent and the discount rate remains 18 percent. Explain why the answer makes sense.

Approach First compute the cash dividend payment for next year (D_1) using the 6 percent growth rate (g) in Equation 9.3. Then apply Equation 9.4 to solve for the firm's stock price.

Solution

$$D_1 = D_0 \times (1 + g)$$

$$D_1 = \$4.81 \times 1.06 = \$5.10$$

$$P_0 = \frac{D_1}{R - g}$$

$$P_0 = \frac{\$5.10}{0.18 - 0.06} = \frac{\$5.10}{0.12} = \$42.50$$

The higher stock value of $42.50 is no surprise because dividends are now growing at a rate of 6 percent rather than 4 percent and the discount rate has not changed. The value of the cash payments to investors (dividends) is expected to be larger.

$$P_t = \frac{D_{t+1}}{R - g} \tag{9.5}$$

Figure 9.14

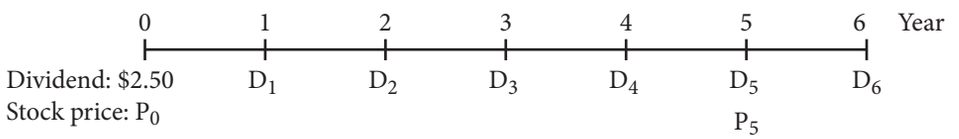


Figure 9.15

$$D_1 = D_0 \times (1 + g) = \$2.50 \times 1.05 = \$2.625$$

Figure 9.16

$$P_0 = \frac{D_1}{R - g} = \frac{\$2.625}{0.15 - 0.05} = \frac{\$2.625}{0.10} = \$26.25$$

Figure 9.17

$$P_5 = \frac{D_6}{R - g}$$

Figure 9.18

$$D_6 = D_0 \times (1 + g)^6 = 2.50 \times (1.05)^6 = 2.50 \times 1.34 = \$3.35$$

Figure 9.19

$$P_5 = \frac{\$3.35}{0.15 - 0.05} = \frac{\$3.35}{0.10} = \$33.50$$

LEARNING BY DOING

APPLICATION 9.3 | Procter & Gamble's Current Stock Price

Problem Suppose that the current cash dividend on Procter & Gamble's common stock is $1.84. Financial analysts expect the dividends to grow at a constant rate of 5 percent per year, and investors require an 8 percent return on stocks with the same level of risk. What should be the current price of a share of Procter & Gamble stock?

Approach In this scenario, $D_0 = \$1.84$, $R = 0.08$, and $g = 0.05$. We first compute D_1 using Equation 9.3. We then calculate the value of a share using Equation 9.4.

Solution

Dividend: $D_1 = D_0 \times (1 + g) = \$1.84 \times 1.05 = \$1.93$

Value of a share: $P_0 = \frac{D_1}{R - g} = \frac{\$1.93}{0.08 - 0.05} = \frac{\$1.93}{0.03} = \$64.33$

APPLICATION 9.4 | Procter & Gamble's Future Stock Price

LEARNING BY DOING

Problem Continuing the example in Learning by Doing Application 9.3, what should Procter & Gamble's stock price be seven years from now (P_7)?

Approach This is an application of Equation 9.5. We first must calculate Procter & Gamble's dividend in period 8, using Equation 9.3. Then we can apply Equation 9.5 to compute the estimated price of the stock seven years in the future.

Solution

Dividend in period 8: $D_8 = D_0 \times (1 + g)^8 = \$1.93 \times (1.05)^8 = \$1.93 \times 1.477 = \$2.85$

Price of a share in 7 years: $P_7 = \frac{D_8}{R - g} = \frac{\$2.85}{0.08 - 0.05} = \frac{\$2.85}{0.03} = \$95.00$

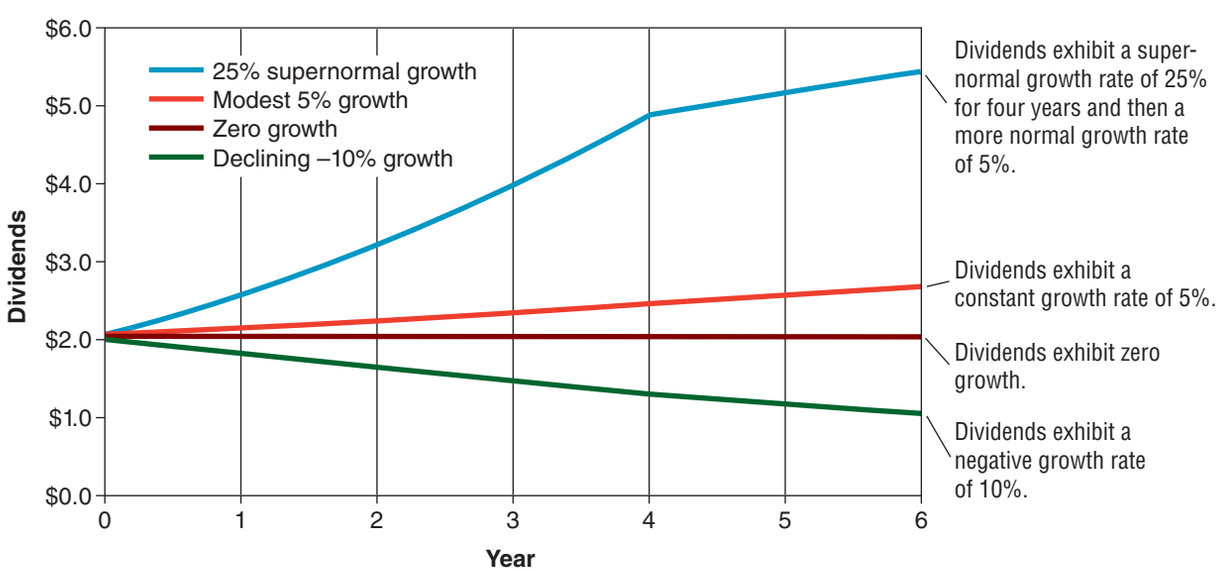


EXHIBIT 9.3 **Dividend Growth Rate Patterns**

Figure 9.20

$$P_0 = \text{PV(Mixed dividend growth)} + \text{PV(Constant dividend growth)}$$

Figure 9.21

$$P_0 = \underbrace{\frac{D_1}{(1+R)} + \frac{D_2}{(1+R)^2} + \frac{D_3}{(1+R)^3}}_{\text{PV of mixed-growth dividend payments}} + \underbrace{\frac{P_3}{(1+R)^3}}_{\text{Value of constant-growth dividend payments}}$$

Figure 9.22

$$\begin{aligned} D_4 &= D_3 \times (1+g) = \$3.00 \times 1.06 = \$3.18 \\ P_3 &= \frac{D_4}{R-g} = \frac{\$3.18}{0.15-0.06} \\ &= \frac{\$3.18}{0.09} \\ &= \$35.33 \end{aligned}$$

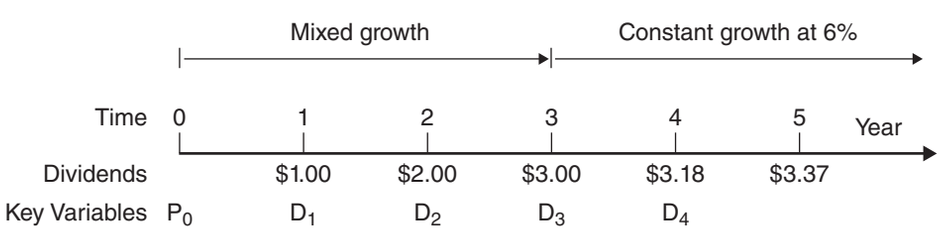


EXHIBIT 9.4 **Time Line for Nonconstant Dividend Growth Pattern**

The exhibit shows a time line for a nonconstant dividend growth pattern. The time line makes it easy to see that we have two different dividend growth patterns. For three years, the dividends are expected to grow at a mixed rate; after that, they are expected to grow at a constant rate of 6 percent.

Figure 9.23

$$P_0 = \frac{\$1.00}{1.15} + \frac{\$2.00}{(1.15)^2} + \frac{\$3.00}{(1.15)^3} + \frac{\$35.33}{(1.15)^3}$$
$$= \$0.87 + \$1.51 + \$1.97 + \$23.23$$
$$= \$27.58$$

$$P_0 = \frac{D_1}{1 + R} + \frac{D_2}{(1 + R)^2} + \cdots + \frac{D_t}{(1 + R)^t} + \frac{P_t}{(1 + R)^t} \qquad (9.6)$$

Figure 9.24

$$P_t = \frac{D_{t+1}}{R - g}$$

Figure 9.25

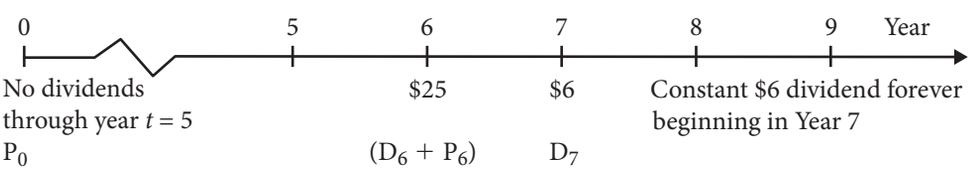


Figure 9.26

P_0 = PV(Mixed dividend growth) + PV(Constant dividends with no growth)

Figure 9.27

$$
\begin{aligned}
P_0 &= \frac{D_1}{1+R} + \frac{D_2}{(1+R)^2} + \cdots + \frac{D_t}{(1+R)^t} + \frac{P_t}{(1+R)^t} \\
&= \frac{D_6}{(1+R)^6} + \frac{P_6}{(1+R)^6} \\
&= \frac{D_6 + P_6}{(1+R)^6}
\end{aligned}
$$

Figure 9.28

$$P_0 = \frac{\$25 + P_6}{(1.12)^6}$$

Figure 9.29

$$P_t = \frac{D_{t+1}}{R - g}$$

Figure 9.30

$$
\begin{aligned}
P_6 &= \frac{D_7}{R - g} = \frac{\$6}{0.12 - 0} = \frac{\$6}{0.12} \\
&= \$50
\end{aligned}
$$

Figure 9.31

$$
\begin{aligned}
P_0 &= \frac{\$25 + \$50}{(1.12)^6} \\
&= \frac{\$75}{1.9738} \\
&= \$38.00
\end{aligned}
$$

Preferred stock price = PV(Dividend payments) + PV(Par value)

$$PS_0 = \frac{D/m}{1 + i/m} + \frac{D/m}{(1 + i/m)^2} + \frac{D/m}{(1 + i/m)^3} + \cdots + \frac{D/m + P_{mn}}{(1 + i/m)^{mn}} \qquad (9.7)$$

Figure 9.32

$$PS_0 = \frac{\$2.50}{1.02} + \frac{\$2.50}{(1.02)^2} + \cdots + \frac{\$102.50}{(1.02)^{80}}$$
$$= \$119.87$$

Figure 9.33

Enter	80	2		2.50	100
	N	i	PV	PMT	FV
Answer			−119.87		

LEARNING BY DOING

APPLICATION 9.5 | Computing the Yield on Preferred Stock

Problem San Diego Gas and Electric (SDG&E) has a preferred stock issue outstanding that has a stated value of $100, will be retired by the company in 15 years, and pays a $2 dividend each quarter. If the preferred stock is currently selling for $95, what is the stock's yield to maturity?

Approach We compute the yield to maturity on this preferred stock in exactly the same way we compute the yield to maturity on a bond. We already know that the quarterly dividend rate is $2, but we must convert the number of periods to allow for quarterly compounding. The total number of compounding periods is 60 (4 periods per year × 15 years = 60 periods). Using Equation 9.7, we can enter the data and find i, the stock's yield to maturity through trial and error. Alternatively, we can solve the problem easily on a financial calculator.

Solution Applying Equation 9.7:

$$\$95 = \frac{\$2}{1 + i} + \frac{\$2}{(1 + i)^2} + \frac{\$2}{(1 + i)^3} + \cdots + \frac{\$102}{(1 + i)^{60}}$$

Financial calculator steps:

Enter	60		−95	2	100
	N	i	PV	PMT	FV
Answer		**2.15**			

The preferred stock's yield is 2.15 percent per quarter, and the annual yield is 8.60 percent (2.15 percent per quarter × 4 quarters per year = 8.60 percent per year).

Figure 9.34

$$P_0 = \frac{D}{R}$$

Figure 9.35

$$P_0 = \frac{D}{R} = \frac{\$5.00}{0.08} = \$62.50$$

Summary of Key Equations

Equation	Description	Formula
9.1	General dividend-valuation model	$P_0 = \frac{D_1}{1+R} + \frac{D_2}{(1+R)^2} + \frac{D_3}{(1+R)^3} + \frac{D_4}{(1+R)^4} + \frac{D_5}{(1+R)^5} + \cdots + \frac{D_\infty}{(1+R)^\infty} = \sum_{t=1}^{\infty} \frac{D_t}{(1+R)^t}$
9.2	Zero-growth dividend model	$P_0 = \frac{D}{R}$
9.3	Value of a dividend at time t with constant growth	$D_t = D_0 \times (1+g)^t$
9.4	Constant-growth dividend model	$P_0 = \frac{D_1}{R-g}$
9.5	Value of a stock at time t when dividends grow at a constant rate	$P_t = \frac{D_{t+1}}{R-g}$
9.6	Mixed (supernormal) growth dividend model	$P_0 = \frac{D_1}{1+R} + \frac{D_2}{(1+R)^2} + \cdots + \frac{D_t}{(1+R)^t} + \frac{P_t}{(1+R)^t}$
9.7	Value of preferred stock with a fixed maturity	$PS_0 = \frac{D/m}{1+i/m} + \frac{D/m}{(1+i/m)^2} + \frac{D/m}{(1+i/m)^3} + \cdots + \frac{D/m + P_{mn}}{(1+i/m)^{mn}}$

Self-Study Problems

9.1 Ted McKay has just bought the common stock of Ryland Corp. Management of Ryland expects the company to grow at the following rates for the next three years: 30 percent, 25 percent, and 15 percent. Last year the company paid a dividend of $2.50. Assume a required rate of return of 10 percent. Compute the expected dividends for the next three years and also the present value of these dividends if dividends grow at the same rate as the company.

9.2 Merriweather Manufacturing Company has been growing at a rate of 6 percent for the past two years, and the company's CEO expects it to continue to grow at this rate for the next several years. The company paid a dividend of $1.20 last year. If your required rate of return is 14 percent, what is the maximum price that you would be willing to pay for this company's stock?

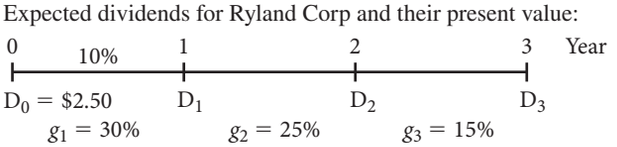
9.3 Clarion Corp. has been selling electrical supplies for the past 20 years. The company's product line has changed very little in the past five years, and the company's management does not expect to add any new items for the foreseeable future. Last year, the company paid a dividend of $4.45 to its common stockholders. The company is not expected to increase its dividends in the future. If your required rate of return for such firms is 13 percent, what is the current value of this company's stock?

9.4 Barrymore Infotech is a fast-growing communications company. The company did not pay a dividend last year and is not expected to do so for the next two years. Last year the company's growth accelerated, and management expects to grow the business at a rate of 35 percent for the next five years before growth slows to a more stable rate of 7 percent. In the third year, management has forecasted a dividend payment of $1.10. Dividends will grow with the company thereafter. Calculate the value of the company's stock at the end of its rapid growth period (i.e., at the end of five years). The required rate of return for such stocks is 17 percent. What is the current value of this stock?

9.5 You are interested in buying the preferred stock of a bank that pays a dividend of $1.80 every quarter. If you discount such cash flows at 8 percent, what is the value of this stock?

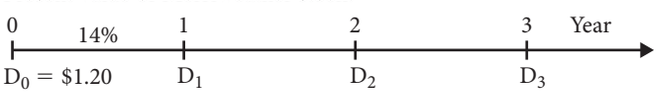
Solutions to Self-Study Problems

9.1 Expected dividends for Ryland Corp and their present value:



$$D_1 = D_0 \times (1 + g_1) = \$2.50 \times (1 + 0.30) = \$3.25$$
$$D_2 = D_1 \times (1 + g_2) = \$3.25 \times (1 + 0.25) = \$4.06$$
$$D_3 = D_2 \times (1 + g_3) = \$4.06 \times (1 + 0.15) = \$4.67$$
$$\text{Present value of the dividends} = PV(D_1) + PV(D_2) + PV(D_3)$$
$$= \$2.96 + \$3.36 + \$3.51$$
$$= \$9.83$$

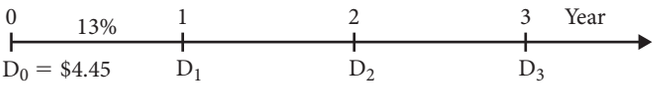
9.2 Present value of Merriweather stock:



$$g = 6\%$$
$$D_1 = D_0 \times (1 + g)$$
$$= \$1.20 \times (1 + 0.06)$$
$$= \$1.27$$
$$P_0 = \frac{D_1}{R - g}$$
$$= \frac{\$1.27}{0.14 - 0.06}$$
$$= \$15.88$$

The maximum price you should be willing to pay for this stock is $15.88.

9.3 Present value of Clarion Corp. stock:



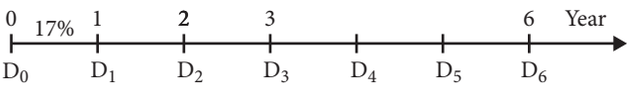
$g = 0\%$

Since the company's dividends are not expected to grow,

$$D_0 = D_1 = D_2 = \cdots = D_\infty = \$4.45 = D$$

$$\text{Current value of the stock} = \frac{D}{R}$$
$$= \$4.45/0.13$$
$$= \$34.23$$

9.4 Present value of Barrymore Infotech stock:



g_1 to $g_5 = 35\%$ $\qquad$ g_6 and beyond $= 7\%$

$D_0 = D_1 = D_2 = 0$

$D_3 = \$1.100$

$D_4 = D_3 \times (1 + g_4) = \$1.10 \times (1 + 0.35) = \$1.485$

$D_5 = D_4 \times (1 + g_5) = \$1.485 \times (1 + 0.35) = \$2.005$

$D_6 = D_5 \times (1 + g_6) = \$2.005 \times (1 + 0.07) = \$2.145$

Value of stock at $t = 5$:

$$P_5 = \frac{D_6}{R - g}$$
$$= \frac{\$2.145}{0.17 - 0.07}$$
$$= \$21.45$$

$$\text{Present value of the dividends in Years 1 to 5} = PV(D_1) + PV(D_2) + PV(D_3) + PV(D_4) + PV(D_5)$$
$$= \$0 + \$0 + \$0.69 + \$0.79 + \$0.91$$
$$= \$2.39$$

Current value of stock:

$$P_0 = PV(\text{Dividends}) + PV(P_5)$$
$$= \$2.39 + \frac{\$21.45}{(1.17)^5}$$
$$= \$2.39 + \$9.78$$
$$= \$12.17$$

9.5 Present value of bank preferred stock:

Quarterly dividend on preferred stock $= D = \$1.80$

Required rate of return $= 8\%$

Current value of stock:

$$P_0 = \frac{D}{R}$$
$$= \frac{\$1.80 \times 4}{0.08}$$
$$= \$90.00$$

Discussion Questions

9.1 Why can the market price of a stock differ from its true (intrinsic) value?

9.2 Why are investors and managers concerned about stock market efficiency?

9.3 Why are common stockholders considered to be more at risk than the holders of other types of securities?

9.4 Under what conditions does it make sense to use the constant-growth dividend model to value a stock?

9.5 What does it mean when a company has a very high P/E ratio? Give examples of industries in which you believe high P/E ratios are justified.

9.6 Explain why preferred stock is considered to be a hybrid of equity and debt securities.

9.7 Why is stock valuation more difficult than bond valuation?

9.8 You are currently thinking about investing in a stock valued at $25.00 per share. The stock recently paid a dividend of $2.25 and its dividend is expected to grow at a rate of 5 percent for the foreseeable future. You normally require a return of 14 percent on stocks of similar risk. Is the stock overpriced, underpriced, or correctly priced?

9.9 Stock A and Stock B are both priced at $50 per share. Stock A has a P/E ratio of 17, while Stock B has a P/E ratio of 24. Which is the more attractive investment, considering everything else to be the same, and why?

9.10 Facebook does not pay dividends. How can it have a positive stock price?

Questions and Problems

Basic

9.1 **Stock market index:** What is a stock market index?

9.2 **Stock market index:** What is the Dow Jones Industrial Average?

9.3 **Stock market index:** What does NASDAQ stand for? What is NASDAQ?

9.4 **Dividend yield:** What is a dividend yield? What does it tell us?

9.5 **Present value of dividends:** Fresno Corp. is a fast-growing company whose management expects it to grow at a rate of 30 percent over the next two years and then to slow to a growth rate of 18 percent for the following three years. If the last dividend paid by the company was $2.15, estimate the dividends for the next five years. Compute the present value of these dividends if the required rate of return is 14 percent.

9.6 **Zero growth:** Nynet, Inc., paid a dividend of $4.18 last year. The company's management does not expect to increase its dividend in the foreseeable future. If the required rate of return is 18.5 percent, what is the current value of the stock?

9.7 **Zero growth:** Knight Supply Corp. has not grown for the past several years, and management expects this lack of growth to continue. The firm last paid a dividend of $3.56. If you require a rate of return of 13 percent, what is the current value of this stock to you?

9.8 **Zero growth:** Ron Santana is interested in buying the stock of First National Bank. While the bank's management expects no growth in the near future, Ron is attracted by the dividend income. Last year the bank paid a dividend of $5.65. If Ron requires a return of 14 percent on such stocks, what is the maximum price he should be willing to pay for a share of the bank's stock?

9.9 **Zero growth:** The current stock price of Largent, Inc., is $44.72. If the required rate of return is 19 percent, what is the dividend paid by this firm if the dividend is not expected to grow in the future?

9.10 **Constant growth:** Moriband Corp. paid a dividend of $2.15 yesterday. The company's dividend is expected to grow at a steady rate of 5 percent for the foreseeable future. If investors in stocks of companies like Moriband require a rate of return of 15 percent, what should be the market price of Moriband stock?

9.11 **Constant growth:** Nyeil, Inc., is a consumer products firm that is growing at a constant rate of 6.5 percent. The firm's last dividend, which was just paid, was $3.36. If the required rate of return is 18 percent, what is the market value of this stock if dividends grow at the same rate as the firm?

9.12 **Constant growth:** Reco Corp. is expected to pay a dividend of $2.25 next year. The forecast for the stock price a year from now is $37.50. If the required rate of return is 14 percent, what is the current stock price? Assume constant growth.

9.13 **Constant growth:** Proxicam, Inc., is expected to grow at a constant rate of 7 percent. If the company's next dividend, which will be paid in a year, is $1.15 and its current stock price is $22.35, what is the required rate of return on this stock?

9.14 **Preferred stock valuation:** X-Centric Energy Company has issued perpetual preferred stock with a stated (par) value of $100 and a dividend of 4.5 percent. If the required rate of return is 8.25 percent, what is the stock's current market price?

9.15 **Preferred stock valuation:** The First Bank of Flagstaff has issued perpetual preferred stock with a $100 par value. The bank pays a quarterly dividend of $1.65 on this stock. What is the current price of this preferred stock given a required rate of return of 11.6 percent?

9.16 **Preferred stock valuation:** The preferred stock of Axim Corp. is currently selling at $47.13. If the required rate of return is 12.2 percent, what is the dividend paid by this stock?

9.17 **Preferred stock valuation:** Each quarter, Sirkota, Inc., pays a dividend on its perpetual preferred stock. Today the stock is selling at $63.37. If the required rate of return for such stocks is 15.5 percent, what is the quarterly dividend paid by Sirkota?

Intermediate

9.18 **Constant growth:** Kay Williams is interested in purchasing the common stock of Reckers, Inc., which is currently priced at $37.45. The company is expected to pay a dividend of $2.58 next year and to increase its dividend at a constant rate of 7 percent.

a. What should the market value of the stock be if the required rate of return is 14 percent?

b. Is this a good buy? Why or why not?

9.19 **Constant growth:** The required rate of return is 23 percent. Ninex Corp. has just paid a dividend of $3.12 and is expected to increase its dividend at a constant rate of 5 percent. What is the expected price of the stock three years from now?

9.20 **Constant growth:** Jenny Banks is interested in buying the stock of Fervan, Inc., which is increasing its dividends at a constant rate of 6 percent. Last year the firm paid a dividend of $2.65. The required rate of return is 16 percent. What is the current value of this stock? What should be the price of the stock in Year 5?

9.21 **Constant growth:** You own shares of Old World DVD Company and are interested in selling them. With so many people downloading music these days, sales, profits, and dividends at Old World have been declining 6 percent per year. The firm just paid a dividend of $1.15 per share. The required rate of return for a stock this risky is 15 percent. If dividends are expected to decline at 6 percent per year, what is a share of the stock worth today?

9.22 **Nonconstant growth:** You own a company that competes with Old World DVD Company (in the previous problem). Instead of selling DVDs, however, your company sells music downloads from a Web site. Things are going well now, but you know that it is only a matter of time before someone comes up with a better way to distribute music. Your company just paid a $1.50 per share dividend, and you expect to increase the dividend 10 percent next year. However, you then expect your dividend growth rate to begin going down—to 5 percent the following year, 2 percent the next year, and to −3 percent per year thereafter. Based on these estimates, what is the value of a share of your company's stock? Assume that the required rate of return is 12 percent.

9.23 **Nonconstant growth:** Tre-Bien, Inc., is a fast-growing technology company. Management projects rapid growth of 30 percent for the next two years, then a growth rate of 17 percent for the following two years. After that, a constant-growth rate of 8 percent is expected. The firm expects to pay its first dividend of $2.45 a year from now. If dividends will grow at the same rate as the firm and the required rate of return on stocks with similar risk is 22 percent, what is the current value of the stock?

9.24 **Nonconstant growth:** Management of ProCor, a biotech firm, forecasted the following growth rates for the next three years: 35 percent, 28 percent, and 22 percent. Management then expects the company to grow at a constant rate of 9 percent forever. The company paid a dividend of $1.75 last week. If the required rate of return is 20 percent, what is the value of this stock?

9.25 **Nonconstant growth:** Revarop, Inc., is a fast-growth company that is expected to grow at a rate of 23 percent for the next four years. It is then expected to grow at a constant rate of 6 percent. Revarop's first dividend, of $4.25, will be paid in Year 3. If the required rate of return is 17 percent, what is the current value of the stock if dividends are expected to grow at the same rate as the company?

9.26 **Nonconstant growth:** Quansi, Inc., management expects to pay no dividends for the next six years. It has projected a growth rate of 25 percent for the next seven years. After seven years, the firm will grow at a constant rate of 5 percent. Its first dividend, to be paid in Year 7, will be $3.25. If the required rate of return is 24 percent, what is the stock worth today?

9.27 **Nonconstant growth:** Staggert Corp. will pay dividends of $5.00, $6.25, $4.75, and $3.00 in the next four years. Thereafter, management expects the dividend growth rate to be constant at 6 percent. If the required rate of return is 18.5 percent, what is the current value of the stock?

9.28 **Nonconstant growth:** Diaz Corp. is expected to grow rapidly at a rate of 35 percent for the next seven years. The company's first dividend, to be paid three years from now, will be $5. After seven years, the company (and the dividends it pays) will grow at a rate of 8.5 percent. What is the value of Diaz stock with a required rate of return of 14 percent?

9.29 **Nonconstant growth:** Tin-Tin Waste Management, Inc., is growing rapidly. Dividends are expected to grow at rates of 30 percent, 35 percent, 25 percent, and 18 percent over the next four years. Thereafter, management expects dividends to grow at a constant rate of 7 percent. The stock is currently selling at $47.85, and the required rate of return is 16 percent. Compute the dividend for the current year (D_0).

Advanced

9.30 Equation 9.4 shows the relation between a stock's value and the dividend that is expected next year if dividends grow at a constant rate forever. If a firm pays all of its earnings as dividends, show how Equation 9.4 can be rearranged to calculate that firm's P/E ratio. What does this tell us about the factors that determine a firm's P/E ratio?

9.31 Riker Departmental Stores management has forecasted a growth rate of 40 percent for the next two years, followed by growth rates of 25 percent and 20 percent for the following two years. It then expects growth to stabilize at a constant rate of 7.5 percent forever. The firm paid a dividend of $3.50 recently. If the required rate of return is 18 percent, what is the current value of Riker's stock?

9.32 Courtesy Bancorp issued perpetual preferred stock a few years ago. The bank pays an annual dividend of $4.27 and your required rate of return is 12.2 percent.

a. What is the value of the stock given your required rate of return?

b. Should you buy this stock if its current market price is $34.41? Explain.

9.33 Rhea Kirby owns shares in Ryoko Corp. Currently, the market price of the stock is $36.34. Management expects dividends to grow at a constant rate of 6 percent for the foreseeable future. Its last dividend was $3.25. Rhea's required rate of return for such stocks is

16 percent. She wants to find out whether she should sell her shares or add to her holdings.

a. What is the value of this stock?

b. Based on your answer to part a, should Rhea buy additional shares in Ryoko Corp? Why or why not?

9.34 Perry, Inc., paid a dividend of $2.50 yesterday. You are interested in investing in this company, which has forecasted a constant-growth rate of 7 percent for its dividends, forever. The required rate of return is 18 percent.

a. Compute the expected dividends D_1, D_2, D_3, and D_4.

b. Compute the present value of these four dividends.

c. What is the expected value of the stock four years from now (P_4)?

d. What is the value of the stock today based on the answers to parts b and c?

e. Use the equation for constant growth (Equation 9.4) to compute the value of the stock today.

9.35 Zweite Pharma is a fast-growing drug company. Management forecasts that in the next three years, the company's dividend growth rates will be 30 percent, 28 percent, and 24 percent, respectively. Last week it paid a dividend of $1.67. After three years, management expects dividend growth to stabilize at a rate of 8 percent. The required rate of return is 14 percent.

a. Compute the dividends for each of the next three years, and calculate their present value.

b. Calculate the price of the stock at the end of Year 3, when the firm settles to a constant-growth rate.

c. What is the current price of the stock?

9.36 Triton Inc., is expected to grow at a rate of 22 percent for the next five years and then settle to a constant-growth rate of 6 percent. The company recently paid a dividend of $2.35. The required rate of return is 15 percent.

a. Find the present value of the dividends during the rapid-growth period if dividends grow at the same rate as the company.

b. What is the value of the stock at the end of Year 5?

c. What is the value of the stock today?

9.37 Ceebros Builders is expanding very fast and is expected to grow at a rate of 25 percent for the next four years. The company recently paid a dividend of $3.60 but is not expected to pay any dividends for the next three years. In Year 4, management expects to pay a $5 dividend and thereafter to increase the dividend at a constant rate of 6 percent. The required rate of return on such stocks is 20 percent.

a. Calculate the present value of the dividends during the fast-growth period.

b. What is the value of the stock at the end of the fast-growth period (P_4)?

c. What is the value of the stock today?

d. Would today's stock value be affected by the length of time you intend to hold the stock?

Sample Test Problems

9.1 Which type of secondary market provides the most efficient market for financial securities?

9.2 Is preferred stock a debt or an equity security?

9.3 Burnes, Inc., is a mature firm that is growing at a constant rate of 5.5 percent per year. The last dividend that the firm paid was $1.50 per share. If dividends are expected to grow at the same rate as the firm and the required rate of return on Burnes's stock is 12 percent, what is the market value of the company's stock?

9.4 Abacus Corporation will pay dividends of $2.25, $2.95, and $3.15 in the next three years. After three years, the dividends are expected to grow at a constant rate of 4 percent per year. If the required rate of return is 14.5 percent, what is the current value of the Abacus common stock?

9.5 The preferred stock of Wellcare Inc. is currently trading at $137.50 per share. If the required rate of return is 8 percent and this stock has no maturity date, what is the quarterly dividend paid by this stock? What is the quarterly dividend if the stock will mature in one year and it has a par value of $140?

EXHIBIT 10.1 **Key Reasons for Making Capital Expenditures**

Capital budgeting decisions are the most important investment decisions made by management.Many of these decisions are routine in nature, but from time to time, managers face broader strategic decisions that call for significant capital investments.

Reason	Description
Renewal:	Over time, equipment must be repaired, overhauled, rebuilt, or retrofitted with new technology to keep the firm's manufacturing or service operations going. For example, a company that has a fleet of delivery trucks may decide to overhaul the trucks and their engines rather than purchase new trucks. Renewal decisions typically do not require an elaborate analysis and are made on a routine basis.
Replacement:	At some point, an asset will have to be replaced rather than repaired or overhauled. The major decision is whether to replace the asset with a similar piece of equipment or purchase equipment that would require a change in the production process. Sometimes, replacement decisions involve equipment that is operating satisfactorily but has become obsolete. The new or retrofitted equipment may provide cost savings with respect to labor or material usage and/or may improve product quality. These decisions typically originate at the plant level.
Expansion:	Strategically, the most important motive for capital expenditures is to expand the level of operating output. One type of expansion decision involves increasing the output of existing products. This may mean new equipment to produce more products or expansion of the firm's distribution system. These types of decisions typically require a more complex analysis than a renewal or replacement decision. Another type of expansion decision involves producing a new product or entering a new market. This type of expansion often involves large dollar amounts and significant business risk and requires the approval of the firm's board of directors.
Regulatory:	Some capital expenditures are required by federal and state regulations. These mandatory expenditures usually involve meeting workplace safety standards and environmental standards.
Other:	This category includes items such as parking facilities, office buildings, and executive aircraft. Many of these capital expenditures are hard to analyze because it is difficult to estimate their cash inflows. Ultimately, the decisions can be more subjective than analytical.

Time line	0	1	2	3	4	5 Year
Cash Flows:						
Initial cost	$-CF_0$					
Cash inflows (CIF)		CIF_1	CIF_2	CIF_3	CIF_4	CIF_5
Cash outflows (COF)		$-COF_1$	$-COF_2$	$-COF_3$	$-COF_4$	$-COF_5$
Salvage value (SV)						SV
Net cash flow	NCF_0	NCF_1	NCF_2	NCF_3	NCF_4	NCF_5

$$NPV = NCF_0 + \sum_{t=1}^{5} \frac{NCF_t}{(1+k)^t}$$

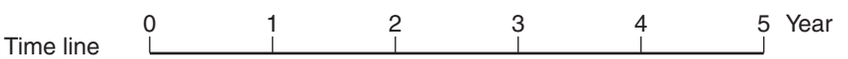
EXHIBIT 10.2 **Sample Worksheet for Net Present Value Analysis**

In addition to following the five-step framework for solving NPV analysis problems, we recommend that you use a worksheet with a time line like the one shown here to help you determine the proper cash flows for each period.

$$NPV = NCF_0 + \frac{NCF_1}{1+k} + \frac{NCF_2}{(1+k)^2} + \cdots + \frac{NCF_n}{(1+k)^n} \qquad (10.1)$$
$$= \sum_{t=0}^{n} \frac{NCF_t}{(1+k)^t}$$

Figure 10.1

$$\begin{aligned}
\text{NPV} &= \sum_{t=0}^{n} \frac{\text{NCF}_t}{(1+k)^t} \\
&= -\$300 + \frac{\$80}{1.15} + \frac{\$80}{(1.15)^2} + \frac{\$80}{(1.15)^3} + \frac{\$80}{(1.15)^4} + \frac{(\$80 + \$30)}{(1.15)^5} \\
&= -\$300 + \$69.57 + \$60.49 + \$52.60 + \$45.74 + \$54.69 \\
&= -\$300 + \$283.09 \\
&= -\$16.91
\end{aligned}$$



Cash Flows:

Initial cost	−$300					
Cash inflows		$300	$300	$300	$300	$300
Cash outflows		−$220	−$220	−$220	−$220	−$220
Salvage value						$ 30
Net cash flow	−$300	$80	$80	$80	$80	$110

EXHIBIT 10.3 **Pocket Pizza Project Time Line and Cash Flows ($ thousands)**

The worksheet introduced in Exhibit 10.2 is helpful in organizing the data given for the pocket pizza project.

Figure 10.2

Enter	3	15		80	30
	N	i	PV	PMT	FV
Answer			**−283.09**		

Figure 10.3

$$\begin{aligned}
\text{NPV} &= \sum_{t=1}^{n} \frac{\text{NCF}_t}{(1+k)^t} - \text{NCF}_0 \\
&= \$283.09 - \$300.00 \\
&= -\$16.91
\end{aligned}$$

APPLICATION 10.1 | The Dough's Up: The Self-Rising Pizza Project

LEARNING BY DOING

Problem Let's continue our frozen pizza example. Suppose the head of the research and development (R&D) group announces that R&D engineers have developed a breakthrough technology—self-rising frozen pizza dough that, when baked, rises and tastes exactly like fresh-baked dough.

The cost is $300,000 to modify the production line and the modifications will have a five-year life. Sales of the new product are estimated at $200,000 for the first year, $300,000 for the next two years, and $500,000 for the final two years. It is estimated that production, sales, and advertising costs will be $250,000 for the first year and will then decline to a constant $200,000 per year. There is no salvage value at the end of the product's life, and the appropriate cost of capital is 15 percent. Is the project, as proposed, economically viable?

Approach To solve the problem, work through the steps for NPV analysis given in the text.

Solution **Exhibit 10.4** shows the project's cash flows.

1. The cost to modify the production line is $300,000, which is a cash outflow in Year 0 and the cost of the project.
2. The future cash flows over the expected life of the project are laid out on the time line in Exhibit 10.4. The project's life is five years. The NCFs for the capital project are negative at the beginning of the project and in the first year (−$300,000 and −$50,000) and thereafter are positive.
3. The appropriate cost of capital is 15 percent.
4. The values are substituted into Equation 10.1 to calculate the NPV:

$$\begin{aligned}
NPV &= NCF_0 + \frac{NCF_1}{1+k} + \frac{NCF_2}{(1+k)^2} + \cdots + \frac{NCF_n}{(1+k)^n} \\
&= -\$300{,}000 + \frac{-\$50{,}000}{1.15} + \frac{\$100{,}000}{(1.15)^2} + \frac{\$100{,}000}{(1.15)^3} + \frac{\$300{,}000}{(1.15)^4} + \frac{\$300{,}000}{(1.15)^5} \\
&= -\$300{,}000 - \$43{,}478 + \$75{,}614 + \$65{,}752 + \$171{,}526 + \$149{,}153 \\
&= \$118{,}567
\end{aligned}$$

5. The NPV for the self-rising pizza dough project is $118,567. Because the NPV is positive, management should accept the project. The project is estimated to increase the value of the firm by $118,567.

Time line	0	1	2	3	4	5 Year
Cash Flows:						
Initial cost	−$300					
Cash inflows		$200	$300	$300	$500	$500
Cash outflows		−$250	−$200	−$200	−$200	−$200
Salvage value						
Net cash flow	−$300	−$50	$100	$100	$300	$300

EXHIBIT 10.4 **Self-Rising Pizza Dough Project Time Line and Cash Flows ($ thousands)** The worksheet shows the time line and cash flows for the self-rising pizza dough project in Learning by Doing Application 10.1. As always, it is important to assign each cash flow to the appropriate year and to give it the proper sign. Once you have computed the net cash flow for each time period, solving for the NPV is just a matter of plugging the data into the NPV formula.

Using Excel

Net Present Value

Net present value problems are most commonly solved using a spreadsheet program. The program's design is good for keeping track of all the cash flows and the periods in which they occur. The spreadsheet setup for Learning by Doing Application 10.1, presented on the right, shows how to calculate the NPV for the self-rising pizza dough machine.

Notice that the NPV formula does not take into account the cash flow in year zero. Therefore, you only enter into the NPV formula the cash flows in Years 1 through 5, along with the discount rate. You then add the cash flow in Year zero to the total from the NPV formula calculation to get the NPV for the investment.

<>	A	B	C	D	E
1					
2		**Net Present Value Calculations**			
3					
4		**Year**		**Cash Flow**	
5		0		–$300,000	
6		1		–50,000	
7		2		100,000	
8		3		100,000	
9		4		300,000	
10		5		300,000	
11					
12		Cost of capital		0.15	
13					
14		**NPV**		**$118,567**	
15		Formula used		=NPV(D12, D6:D10)+D5	
16					

EXAMPLE 10.1 | The IS Department's Capital Projects

DECISION MAKING

Situation Suppose you are the manager of the information systems (IS) department of the frozen pizza manufacturer we have been discussing. Your department has identified four possible capital projects with the following NPVs: (1) $4,500, (2) $3,000, (3) $0.0, and (4) −$1,000. What should you decide about each project if the projects are independent? What should you decide if the projects are mutually exclusive?

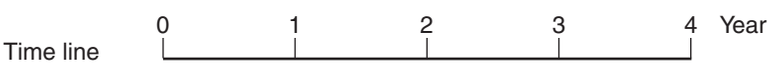
Decision If the projects are independent, you should accept Projects 1 and 2, both of which have a positive NPV, and reject Project 4. Project 3, with an NPV of zero, could be either accepted or rejected without affecting the value of the firm. If the projects are mutually exclusive and you can accept only one of them, it should be Project 1, which has the largest NPV.

Summary of Net Present Value (NPV) Method

Decision Rule: NPV > 0 ⇨ Accept the project.
NPV < 0 ⇨ Reject the project.

Key Advantages	Key Disadvantage
1. Uses the discounted cash flow valuation technique to adjust for the time value of money.	**1.** Can be difficult to understand without an accounting and finance background.
2. Provides a direct (dollar) measure of how much a capital project will increase the value of the firm.	
3. Is consistent with the goal of maximizing stockholder value.	

$$\text{PB} = \text{Years before cost recovery} + \frac{\text{Remaining cost to recover}}{\text{Cash flow during the year}} \qquad (10.2)$$



Net cash flow (NCF)	−$70,000	$30,000	$30,000	$20,000	$15,000
Cumulative NCF	−$70,000	−$40,000	−$10,000	$10,000	$25,000

EXHIBIT 10.5 **Payback Period Cash Flows and Calculations**

The exhibit shows the net and cumulative net cash flows for a proposed capital project with an initial cost of $70,000. The cash flow data are used to compute the payback period, which is 2.5 years.

APPLICATION 10.2 | A Payback Calculation

LEARNING BY DOING

Problem A firm has two capital projects, A and B, which are under review for funding. Both projects cost $500, and the projects have the following cash flows:

Year	Project A	Project B
0	−$500	−$500
1	100	400
2	200	300
3	200	200
4	400	100

What is the payback period for each project? If the projects are independent, which project should management select? If the projects are mutually exclusive, which project should management accept? The firm's payback cutoff point is two years.

Approach Use Equation 10.2 to calculate the number of years it takes for the cash flows from each project to recover the project's initial investment. If the two projects are independent, you should accept the projects that have a payback period that is less than or equal to two years. If the projects are mutually exclusive, you should accept the project with the shorter payback period if that payback period is less than or equal to two years.

Solution Computing the payback for Project A requires only that we calculate the first term in Equation 10.2—Years before recovery: the first year recovers $100, the second year $200, and the third year $200, for a total of $500 ($100 + $200 + $200 = $500). Thus, in three years, the $500 investment is fully recovered, so $PB_A = 3.00$ years.

For Project B, the first year recovers $400 and the second year $300. Since we need only part of the second-year cash flow to recover the initial cost, we calculate both terms in Equation 10.2 to obtain the payback period.

$$\text{PB} = \text{Years before cost recovery} + \frac{\text{Remaining cost to recover}}{\text{Cash flow during the year}}$$

$$\text{PB}_A = 3 \text{ years}$$

$$\text{PB}_B = 1 \text{ year} + \frac{\$500 - \$400}{\$300 \text{ per year}}$$

$$= 1 \text{ year} + \frac{\$100}{\$300 \text{ per year}}$$

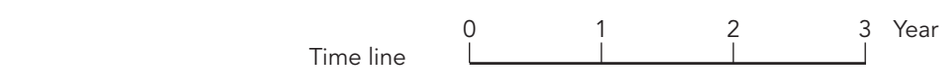
$$= 1.33 \text{ years}$$

Whether the projects are independent or mutually exclusive, management should accept only Project B since Project A's payback period exceeds the two-year cutoff point.

EXHIBIT 10.6 **Payback Period with Various Cash Flow Patterns**

Each of the five capital budgeting projects shown in the exhibit calls for an initial investment of $500, but all have different cash flow patterns. The bottom part of the exhibit shows each project's payback period, along with its net present value for comparison.

Year	A	B	C	D	E
0	−$500	−$500	−$500	−$500	−$500
1	200	300	250	500	200
2	300	100	250	0	200
3	400	50	−250	0	200
4	500	0	250	−5,000	5,000
Payback (years)	2.0	∞	2.0/4.0	1.0/∞	2.5
NPV	$450	−$131	−$115	−$2,924	$2,815
Cost of capital = 15%					



Net cash flow (NCF)	−$40,000	$20,000	$20,000	$20,000
Cumulative NCF	−$40,000	−$20,000	$0	$20,000
Discounted NCF (at 10%)	−$40,000	$18,182	$16,529	$15,026
Cumulative discounted NCF	−$40,000	−$21,818	−$5,289	$9,737

Payback period = 2 years + $0/$20,000 per year = 2 years

Discounted payback period = 2 years + $5,289/$15,026 year = 2.35 years

Cost of capital = 10%

NPV = $49,737 − $40,000 = $9,737

EXHIBIT 10.7 **Discounted Payback Period Cash Flows and Calculations**

The exhibit shows the net and cumulative net cash flows for a proposed capital project with an initial cost of $40,000. The cash flow data are used to compute the discounted payback period for a 10 percent cost of capital, which is 2.35 years.

Summary of Payback Method

Decision Rule:

Payback period ≤ Payback cutoff point ⇨ Accept the project.
Payback period > Payback cutoff point ⇨ Reject the project.

Key Advantages	Key Disadvantage
1. Easy to calculate and understand for people without a strong accounting and finance background. **2.** A simple measure of a project's liquidity risk.	**1.** Most common version does not account for time value of money. **2.** Does not consider cash flows past the payback period. **3.** Bias against long-term projects such as research and development and new product launches. **4.** Arbitrary cutoff point.

$$\text{ARR} = \frac{\text{Average net income}}{\text{Average book value}} \tag{10.3}$$

$$\begin{aligned}\text{NPV} &= \text{NCF}_0 + \frac{\text{NCF}_1}{1 + \text{IRR}} + \frac{\text{NCF}_2}{(1 + \text{IRR})^2} + \cdots + \frac{\text{NCF}_n}{(1 + \text{IRR})^n} \\ &= \sum_{t=0}^{n} \frac{\text{NCF}_t}{(1 + \text{IRR})^t} = 0\end{aligned} \tag{10.4}$$

Calculating the IRR

The IRR is an expected rate of return much like the yield to maturity we calculated for bonds in Chapter 8. Thus, in calculating the IRR, we need to apply the same trial-and-error method we used in Chapter 8. We will begin by doing some IRR calculations by trial and error so that you understand the process, and then we will switch to the financial calculator and computer spreadsheets, which provide an answer more quickly.

Trial-and-Error Method

Suppose that Ford Motor Company has an investment opportunity with cash flows as shown in **Exhibit 10.8** and that the cost of capital is 12 percent. We want to find the IRR for this project. Using Equation 10.4, we will substitute various values for IRR into the equation to compute the project's IRR by trial and error. We continue this process until we find the IRR value that makes Equation 10.4 equal zero.

A good starting point is to use the cost of capital as the discount rate. Note that when we discount the NCFs by the cost of capital, we are calculating the project's NPV:

$$\text{NPV} = \text{NCF}_0 + \frac{\text{NCF}_1}{1 + \text{IRR}} + \frac{\text{NCF}_2}{(1 + \text{IRR})^2} + \cdots + \frac{\text{NCF}_n}{(1 + \text{IRR})^n}$$

$$\text{NPV}_{12\%} = -\$560 + \frac{\$240}{1.12} + \frac{\$240}{(1.12)^2} + \frac{\$240}{(1.12)^3} = \$16.44$$

Recall that the result we are looking for is zero. Because our result is greater than zero ($16.44), the discount rate of 12 percent is too low, and we must try a higher rate. Let's try 13 percent:

$$\text{NPV}_{13\%} = -\$560 + \frac{\$240}{1.13} + \frac{\$240}{(1.13)^2} + \frac{\$240}{(1.13)^3} = \$6.68$$

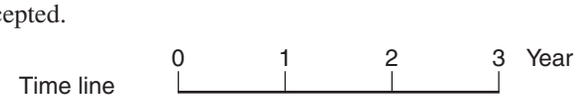
We are very close; let's try 14 percent:

$$\text{NPV}_{14\%} = -\$560 + \frac{\$240}{1.14} + \frac{\$240}{(1.14)^2} + \frac{\$240}{(1.14)^3} = -\$2.81$$

Because our result is now a negative number, we know the correct rate is between 13 percent and 14 percent, and looking at the magnitude of the numbers, we know that the answer is closer to 14 percent. Let's try 13.7 percent.

$$\text{NPV}_{13.7\%} = -\$560 + \frac{\$240}{1.137} + \frac{\$240}{(1.137)^2} + \frac{\$240}{(1.137)^3} = 0$$

Good guess! This means that the NPV of Ford's capital project is zero at a discount rate of 13.7 percent. The required rate of return is the cost of capital, which is 12.0 percent. Since the project's IRR of 13.7 percent exceeds the cost of capital, the IRR criterion indicates that the project should be accepted.



Net cash flow	−$560	$240	$240	$240

Cost of capital = 12%

NPV = $576.44 − $560.00 = $16.44

EXHIBIT 10.8 Time Line and Expected Net Cash Flows for the Ford Motor Company Project ($ thousands)

The cash flow data in the exhibit are used to compute the project's IRR. The project's NPV is a positive $16,440, which indicates that the IRR is greater than the cost of capital of 12 percent.

The project's NPV is a positive $16,440, which also indicates that Ford should go ahead with the project. Thus, both the IRR and NPV suggest the same conclusion.

Learning by Doing Application 10.3 and the following **Using Excel Example** illustrate additional IRR calculations.

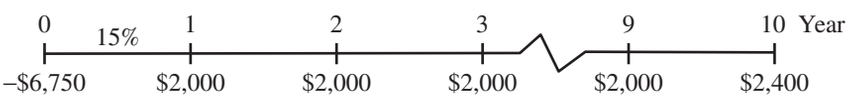
LEARNING BY DOING

APPLICATION 10.3 | Calculating the IRR at Larry's Homemade Ice Cream Shop

Problem Larry's Homemade Ice Cream Shop in the DuPont Circle area of Washington, D.C., is famous for its gourmet ice cream. However, some customers have asked for a healthy, low-cal, soft yogurt. The machine that makes this confection is manufactured in Italy and costs $5,000 plus $1,750 for installation. Larry estimates that the machine will generate a net cash flow of $2,000 a year. Larry also estimates the machine's life to be 10 years and that it will have a $400 salvage value. His cost of capital is 15 percent. Larry thinks the machine is overpriced. Is he right?

Approach The IRR for an investment is the discount rate at which the NPV is zero. Thus, we can use Equation 10.4 to solve for the IRR and then compare this value with Larry's cost of capital. If the IRR is greater than the cost of capital, the project has a positive NPV and should be accepted.

Solution The total cost of the machine is $6,750 ($5,000 + $1,750 = $6,750), and the final cash flow in Year 10 is $2,400 ($2,000 + $400 = $2,400).



The hand trial-and-error calculations are shown below. The first calculation uses 15 percent, the cost of capital, our recommended starting point, and the answer is $3,386.41 (which is also the project's NPV). Because the value is a positive number, we need to use a discount rate larger than 15 percent. Our guess is 27.08 percent. At that value the NPV equals zero; thus, the IRR for the yogurt machine is 27.08 percent.

$$NPV = NCF_0 + \frac{NCF_1}{1 + IRR} + \frac{NCF_2}{(1 + IRR)^2} + \cdots + \frac{NCF_n}{(1 + IRR)^n} = 0$$

$$NPV_{15.00\%} = -\$6{,}750 + \frac{\$2{,}000}{1.15} + \frac{\$2{,}000}{(1.15)^2} + \cdots + \frac{\$2{,}400}{(1.15)^{10}} = \$3{,}386.41$$

$$NPV_{27.08\%} = -\$6{,}750 + \frac{\$2{,}000}{1.2708} + \frac{\$2{,}000}{(1.2708)^2} + \cdots + \frac{\$2{,}400}{(1.2708)^{10}} = \$0.00$$

Because the project's future cash flow pattern resembles that for a coupon bond, we can also solve for the IRR using a financial calculator, just as we would solve for the yield to maturity of a bond. Just enter the data directly into the corresponding keys on the calculator, press the interest key, and we have our answer: 27.08 percent.

Enter	10		–6,750	2,000	400
	N	i	PV	PMT	FV
Answer		**27.08**			

As with present value calculations, for projects with unequal cash flows, you should consult your financial calculator's manual.

Because the project's IRR exceeds Larry's cost of capital of 15 percent, the project should be accepted. Larry is wrong.

Using Excel

Internal Rate of Return

You know that calculating IRR by hand can be tedious. The trial-and-error method can take a long time and can be quite frustrating. Knowing all the cash flows and an approximate rate will allow you to use a spreadsheet formula to get an answer instantly.

The accompanying spreadsheet shows the setup for calculating the IRR for the low-cal yogurt machine at Larry's Homemade Ice Cream Shop that is described in Learning by Doing Application 10.3.

Here are a couple of important points to note about IRR calculations using spreadsheet programs:

1. Unlike the NPV formula, the IRR formula accounts for all cash flows, including the initial investment in Year 0, so there is no need to add this cash flow later.
2. The syntax of the IRR function requires that you first provide the project's cash flows in order beginning at time zero. To calculate the IRR, you will also need to provide a "guess" value, or a number you estimate is close to the IRR. A good value to start with is the cost of capital. To learn more about why this value is needed, you should go to your spreadsheet's help manual and search for "IRR."

	A	B	C	D	E
1					
2		**IRR Calculations**			
3					
4		**Year**		**Cash Flow**	
5		0		−$6,750	
6		1		2,000	
7		2		2,000	
8		3		2,000	
9		4		2,000	
10		5		2,000	
11		6		2,000	
12		7		2,000	
13		8		2,000	
14		9		2,000	
15		10		2,400	
16					
17		Cost of capital		0.15	
18					
19		**IRR**		**27.08%**	
20		Formula used		=IRR(D5:D15, D17)	
21					
22	Remember to keep track of signs—cash outflows are negative, and cash inflows are positive.				
23					
24					

Figure 10.4

Discount Rate	NPV ($ thousands)
0%	$160
5	94
10	37
15	−12
20	−54
25	−92
30	−124

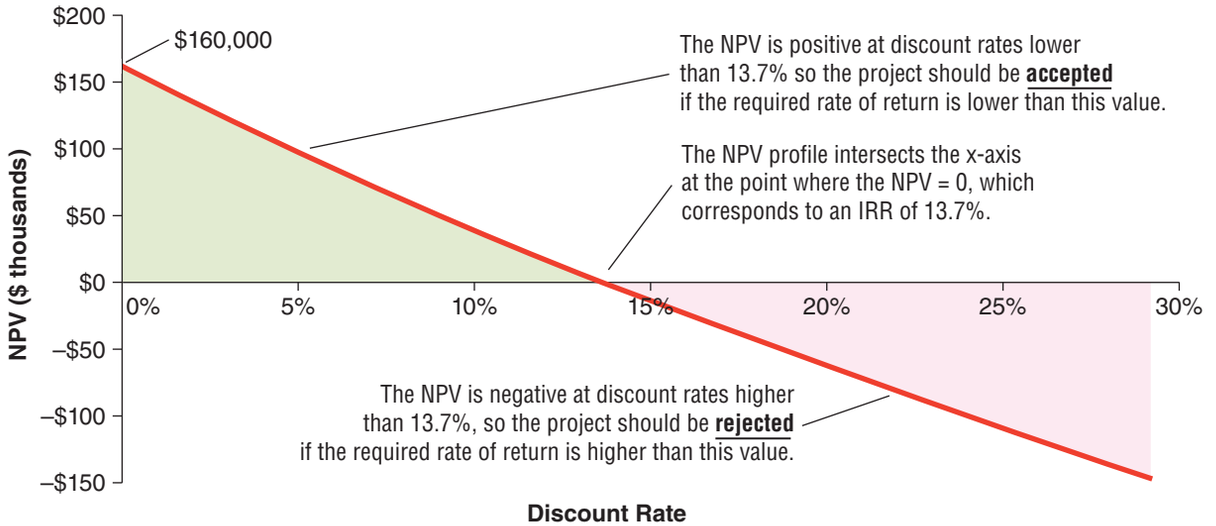


EXHIBIT 10.9 **NPV Profile for the Ford Motor Company Project**

In the NPV profile for the Ford Motor Company project, the NPV value is on the vertical (y) axis and the discount rate is on the horizontal (x) axis. You can see that as the discount rate increases, the NPV profile curve declines smoothly and intersects the x-axis at the point where the NPV is 0. The IRR of 13.7 percent is the point at which the NPV changes from a positive to a negative value. The NPV and IRR methods lead to identical accept-or-reject decisions for the Ford Motor Company project.

Figure 10.5

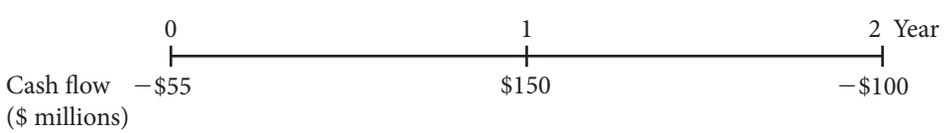


Figure 10.6

Discount Rate	NPV ($ millions)
0%	−$5.00
10	−1.28
20	0.56
30	1.21
40	1.12
50	0.56
60	−0.31
70	−1.37

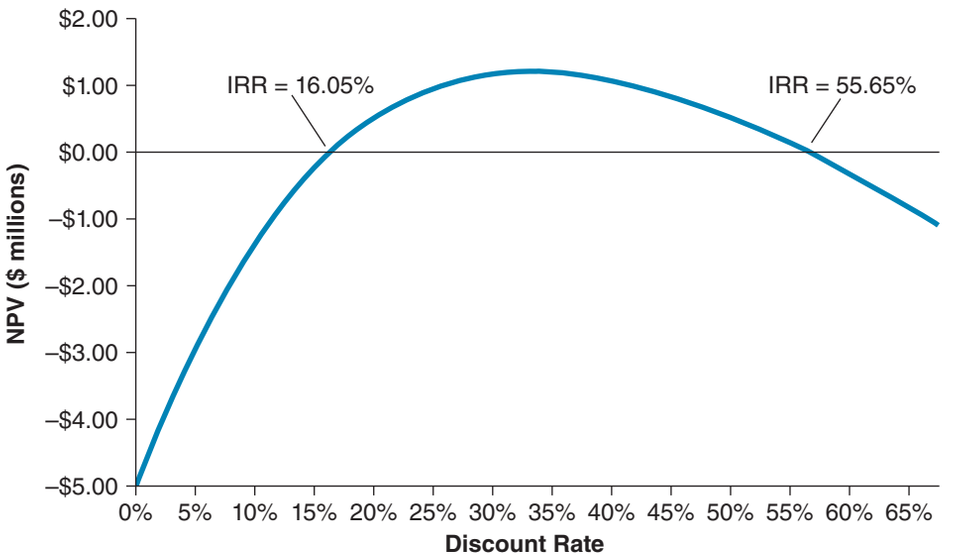


EXHIBIT 10.10 **NPV Profile for Gold-Mining Operation with Multiple IRR Solutions**

The gold-mining operation has unconventional cash flows. Because there are two cash flow sign reversals, we end up with two IRRs—16.05 percent and 55.65 percent—neither of them useful. In situations like this, the IRR provides a solution that is meaningless and, therefore, the results should not be used for capital budgeting decisions.

Figure 10.7

Year	Project A	Project B
0	–$100	–$100
1	50	20
2	40	30
3	30	50
4	30	65

Figure 10.8

Discount Rate	NPV of Project A	NPV of Project B
0%	$50.0	$65.0
5	34.5	42.9
10	21.5	24.9
13	14.8	15.7
15	10.6	10.1
20	1.3	–2.2
25	–6.8	–12.6
30	–13.7	–21.3
IRR	20.7%	19.0%

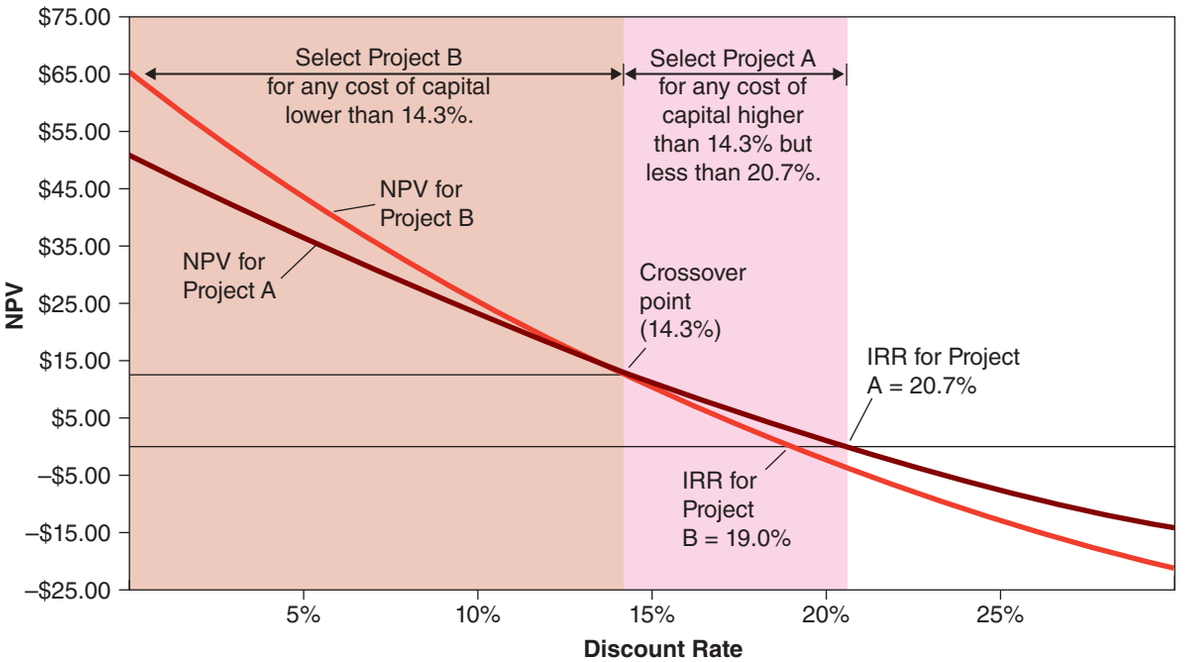


EXHIBIT 10.11 **NPV Profiles for Two Mutually Exclusive Projects**

The NPV profiles for two projects often cross over each other. When evaluating mutually exclusive projects, it is helpful to know where this crossover point is. For Projects A and B in the exhibit, the crossover point is at 14.3 percent. For any cost of capital above 14.3 percent but below 20.7 percent, the NPV for Project A is higher than that for Project B and is positive; thus, Project A should be selected. For any cost of capital below the crossover point, the NPV of Project B is higher, and Project B should be selected.

EXAMPLE 10.2 | The Lemonade Stand versus the Convenience Store

DECISION MAKING

Situation Suppose you work for an entrepreneur who owns a number of small businesses in Fresno, California, as well as a small piece of property near California State University at Fresno, which he believes would be an ideal site for a student-oriented convenience store. His 7-year-old son, who happens to be in the office after school, says he has a better idea: his father should open a lemonade stand. Your boss tells you to find the NPV and IRR for both projects, assuming a 10 percent discount rate. After collecting data, you present the following analysis:

Year	Lemonade Stand	Convenience Store
0	−$1,000	−$1,000,000
1	850	372,000
2	850	372,000
3	850	372,000
4	850	372,000
IRR	76.2%	18.0%
NPV	$1,694	$179,190

Assuming the projects are mutually exclusive, which should be selected?

Decision Your boss, who favors the IRR method, looks at the analysis and declares his son a genius. The IRR decision rule suggests that the lemonade stand, with its 76.2 percent rate of return, is the project to choose! You point out that the goal of capital budgeting is to select projects, or combinations of projects, that maximize the value of the firm, his business. The convenience store adds by far the greater value: $179,190 compared with only $1,694 for the lemonade stand. Although the lemonade stand has a high rate of return, its small size precludes it from being competitive against the larger project.

$$\text{PV(Cost of the project)} = \text{PV(Expected cash inflows)}$$

$$\text{PV}_{\text{Cost}} = \text{PV}_{\text{PFV}}$$

$$\text{PV}_{\text{Cost}} = \frac{\text{PFV}}{(1 + \text{MIRR})^n} \tag{10.5}$$

Figure 10.9

$$\text{PFV} = [\text{CF}_1 \times (1 + k)^{n-1}] + [\text{CF}_2 \times (1 + k)^{n-2}] + \ldots + [\text{CF}_n \times (1 + k)^{n-n}]$$

$$= \sum_{t=1}^{n} \text{CF}_t \times (1 + k)^{n-t}$$

Figure 10.10

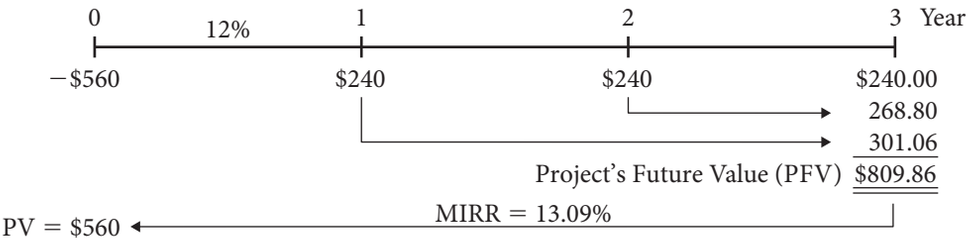


Figure 10.11

$$\begin{aligned}\text{PFV} &= [\text{CF}_1 \times (1 + k)^{n-1}] + [\text{CF}_2 \times (1 + k)^{n-2}] + \cdots + [\text{CF}_n \times (1 + k)^{n-n}] \\ &= [\$240 \times (1.12)^2] + [\$240 \times 1.12] + \$240 = \$809.86\end{aligned}$$

Figure 10.12

$$\begin{aligned}\text{PV}_{\text{Cost}} &= \frac{\text{PFV}}{(1 + \text{MIRR})^n} \\ \$560 &= \frac{\$809.86}{(1 + \text{MIRR})^3} \\ (1 + \text{MIRR})^3 &= \frac{\$809.86}{\$560} = 1.4462 \\ 1 + \text{MIRR} &= (1.4462)^{1/3} = 1.1309 \\ \text{MIRR} &= 1.1309 - 1 = 0.1309 \\ &= 13.09\%\end{aligned}$$

Summary of Internal Rate of Return (IRR) Method	
Decision Rule:	**IRR > Cost of capital ⇨ Accept the project.** **IRR < Cost of capital ⇨ Reject the project.**
Key Advantages	**Key Disadvantage**
1. Intuitive and easy to understand. **2.** Based on discounted cash flow technique.	**1.** With nonconventional cash flows, IRR approach can yield no usable answer or multiple answers. **2.** A lower IRR can be better if a cash inflow is followed by cash outflows. **3.** With mutually exclusive projects, IRR can lead to incorrect investment decisions. **4.** IRR calculation assumes cash flows are reinvested at the IRR.

$$\text{PI} = \frac{\text{Benefits}}{\text{Costs}} = \frac{\text{Present value of future free cash flows}}{\text{Initial investment}} = \frac{\text{NPV} + \text{Initial investment}}{\text{Initial investment}} \qquad (10.6)$$

Figure 10.13

$$\text{PI} = (\$20{,}189 + \$2{,}000)/\$2{,}000 = 11.09$$

EXHIBIT 10.12 **Positive NPV Investments This Year**

With only $10,000 to invest, how do we choose among these four positive NPV projects? The exhibit shows the yearly free cash flows, NPV, and profitability index (PI) for the projects. The PI values indicate the value of the expected future free cash flows per dollar invested in each project.

Project	Year 0	Year 1	Year 2	NPV @ 10%	PI
A	−$5,000	$5,500	$6,050	$5,000	2.000
B	−$3,000	$2,000	$3,850	$2,000	1.667
C	−$3,000	$4,400	$0	$1,000	1.333
D	−$2,000	$1,500	$1,375	$500	1.250

LEARNING BY DOING

APPLICATION 10.4 | Ranking Projects Using the Profitability Index

Problem You have identified the following seven positive NPV investments for your in-home computer-support business. If you have $50,000 to invest this year, which projects should you accept?

Project	Investment	NPV @ 10%
Buy new notebook computer	$ 3,000	$ 500
Buy employee training program	8,000	4,000
Buy new tool set	500	1,000
Buy office condo	40,000	5,000
Buy used car	12,000	4,000
Paint existing cars	4,000	2,000
Buy new test equipment	10,000	2,000

Approach Use the four-step procedure presented in the text to determine which projects you should accept.

Solution Calculating the PI and ranking the projects from highest to lowest PI yields the following:

Project	Investment	NPV @ 10%	PI
Buy new tool set	$ 500	$1,000	$1,500/$500 = 3.000
Buy employee training program	8,000	4,000	$12,000/$8,000 = 1.500
Paint existing cars	4,000	2,000	$6,000/$4,000 = 1.500
Buy used car	12,000	4,000	$16,000/$12,000 = 1.333
Buy new test equipment	10,000	2,000	$12,000/$10,000 = 1.200
Buy new notebook computer	3,000	500	$3,500/$3,000 = 1.167
Buy office condo	40,000	5,000	$45,000/$40,000 = 1.125

With $50,000 to invest, you should invest in all projects except the office condo. This strategy will require $37,500 and is expected to result in a total NPV of $13,500. The $12,500 that you have left over, which is not enough to buy the office condo, can be held in the business until an appropriate use for the money is identified, or it can be distributed to the stockholder (you).

DECISION MAKING

EXAMPLE 10.3 | Ranking Investment Alternatives

Situation The profitability index concept does not apply only to a firm's investments in projects. It can also apply to your personal investments. For example, suppose that you have just inherited $50,000 and want to invest it in ways that create as much value as possible. After researching investment alternatives, you have identified five investments that you believe will have positive NPVs. You estimate that the NPVs and Pls for these investments are as follows:

Project	Investment	NPV	PI
But a new car for your business	$20,000	$10,000	1.500
Buy a duplex apartment near campus	50,000	22,500	1.450
Start a small moving business	25,000	10,000	1.400
Invest in your roommate's Internet business	15,000	5,000	1.333
Buy a collection of old comic books	5,000	1,000	1.200

Which investment(s) should you choose?

Decision You should invest in the duplex apartment. If you began the selection process by choosing the new car because it has the largest Pl and then work your way down the list until you reach a total investment of $50,000, you will see that you can invest in the car, the moving business, and the comic books. These three investments have a total NPV of $21,000. However, the investment in the duplex apartment alone has an NPV of $22,500. Investing in the duplex apartment will create more total value.

This problem illustrates why the procedure for using Pl to choose projects has four steps. Without the fourth step, which tells us to repeat the third step beginning with the second project, the third project, and so on, we would not have identified the duplex apartment as the best alternative.

EXHIBIT 10.13 **Positive NPV Investments for Two Years**

Investment decision making with capital rationing becomes more complex when multiple periods are involved. This exhibit shows the yearly free cash flows, NPV, and profitability index (PI) for the four positive NPV projects in Exhibit 10.12 and for three other positive-NPV projects that are expected to become available in Year 1.

Project	Year 0	Year 1	Year 2	Year 3	Year 0 NPV @ 10%	PI
A	−$5,000	$5,500	$6,050	$0	$5,000	2.000
B	−$3,000	$2,000	$3,850	$0	$2,000	1.667
C	−$3,000	$4,400	$0	$0	$1,000	1.333
D	−$2,000	$1,500	$1,375	$0	$500	1.250
F		−$10,000	$12,000	$11,000	$9,091	1.909
G		−$10,000	$8,000	$11,770	$6,364	1.636
H		−$5,000	$4,000	$2,255	$455	1.091

Figure 10.14

Company	2016 Capital Expenditures ($ billions)	2016 Sales ($ billions)	Capital Expenditures as a Percentage of Sales
AT&T, Inc.	$21.5	$163.8	13.1%
Caterpillar, Inc.	2.9	38.5	7.5
Microsoft Corp.	8.3	85.3	9.7
Kellogg Company	0.5	13.0	3.8

EXHIBIT 10.14 **Capital Budgeting Techniques Used by Business Firms**

The exhibit summarizes evidence from two studies that examined the use of capital budgeting techniques by businesses. As you can see, over time more firms have come to use the NPV and IRR techniques. Surprisingly, though, even in 1999, 20.3 percent still computed the accounting rate of return.

	Percent of Surveyed Firms That Use the Technique Frequently	
Capital Budgeting Tool	1981	1999
Payback period	5.0%	56.7%
Accounting rate of return (ARR)	10.7	20.3
Internal rate of return (IRR)	65.3	75.7
Net present value (NPV)	16.5	74.9

Sources: Stanley, Marjorie T., and Stanley B. Block, "A Survey of Multinational Capital Budgeting," *The Financial Review*, March 1984. Graham, John R., and Campbell R. Harvey, "The Theory and Practice of Corporate Finance," *Journal of Financial Economics*, May/June 2001.

Summary of Key Equations

Equation	Description	Formula
10.1	Net present value	$\text{NPV} = \text{NCF}_0 + \frac{\text{NCF}_1}{1+k} + \frac{\text{NCF}_2}{(1+k)^2} + \cdots + \frac{\text{NCF}_n}{(1+k)^n} = \sum_{t=0}^{n} \frac{\text{NCF}_t}{(1+k)^t}$
10.2	Payback period	$\text{PB} = \text{Years before cost recovery} + \frac{\text{Remaining cost to recover}}{\text{Cash flow during the year}}$
10.3	Accounting rate of return	$\text{ARR} = \frac{\text{Average net income}}{\text{Average book value}}$
10.4	Internal rate of return	$\text{NPV} = \sum_{t=0}^{n} \frac{\text{NCF}_t}{(1+\text{IRR})^t} = 0$
10.5	Modified internal rate of return	$\text{PV}_{\text{Cost}} = \frac{\text{PFV}}{(1+\text{MIRR})^n}$
10.6	Profitability index	$\text{PI} = \frac{\text{NPV} + \text{Initial investment}}{\text{Initial investment}}$

Self-Study Problems

10.1 The management of Premium Manufacturing Company is evaluating two forklift systems to use in its plant that produces the towers for a windmill power farm. The costs and the cash flows from these systems are shown below. If the company uses a 12 percent discount rate for all projects, determine which forklift system should be purchased using the net present value (NPV) approach.

	Year 0	Year 1	Year 2	Year 3
Otis Forklifts	−$3,123,450	$979,225	$1,358,886	$2,111,497
Craigmore Forklifts	−$4,137,410	$875,236	$1,765,225	$2,865,110

10.2 Perryman Crafts Corp. management is evaluating two independent capital projects that will each cost the company $250,000. The two projects are expected to provide the following cash flows:

Year	Project A	Project B
1	$ 80,750	$ 32,450
2	93,450	76,125
3	40,235	153,250
4	145,655	96,110

Which project will be chosen if the company's payback criterion is three years? What if the company accepts all projects as long as the payback period is less than five years?

10.3 Terrell Corp. management is considering purchasing a machine that will cost $117,250 and will be depreciated on a straight-line basis over a five-year period. The sales and expenses (excluding depreciation) for the next five years are shown in the following table. The company's tax rate is 34 percent.

	Year 1	Year 2	Year 3	Year 4	Year 5
Sales	$123,450	$176,875	$242,455	$255,440	$267,125
Expenses	$137,410	$126,488	$141,289	$143,112	$133,556

Terrell will accept all projects that provide an accounting rate of return (ARR) of at least 45 percent. Should the company accept this project?

10.4 Refer to Problem 10.1. Compute the IRR for each of the two systems. Is the investment decision different from the one indicated by NPV?

10.5 You are considering a project that has an initial outlay of $1 million. The profitability index of the project is 2.24. What is the NPV of the project?

Solutions to Self-Study Problems

10.1 NPVs for two forklift systems:

NPV for Otis Forklifts:

$$\begin{aligned}
NPV_{Otis} &= \sum_{t=0}^{n} \frac{NCF_t}{(1+k)^t} \\
&= -\$3{,}123{,}450 + \frac{\$979{,}225}{1.12} + \frac{\$1{,}358{,}886}{(1.12)^2} + \frac{\$2{,}111{,}497}{(1.12)^3} \\
&= -\$3{,}123{,}450 + \$874{,}308 + \$1{,}083{,}296 + \$1{,}502{,}922 \\
&= \$337{,}076
\end{aligned}$$

NPV for Craigmore Forklifts:

$$\begin{aligned}
NPV_{Craigmore} &= \sum_{t=0}^{n} \frac{NCF_t}{(1+k)^t} \\
&= -\$4{,}137{,}410 + \frac{\$875{,}236}{1.12} + \frac{\$1{,}765{,}225}{(1.12)^2} + \frac{\$2{,}865{,}110}{(1.12)^3} \\
&= -\$4{,}137{,}410 + \$781{,}461 + \$1{,}407{,}227 + \$2{,}039{,}329 \\
&= \$90{,}607
\end{aligned}$$

Premium should purchase the Otis forklift since it has a larger NPV.

10.2 Payback periods for Perryman projects A and B:

Project A		
Year	**Cash Flow**	**Cumulative Cash Flows**
0	($250,000)	($250,000)
1	80,750	(169,250)
2	93,450	(75,800)
3	40,235	(35,565)
4	145,655	110,090

Project B		
Year	**Cash Flow**	**Cumulative Cash Flows**
0	($250,000)	($250,000)
1	32,450	(217,550)
2	76,125	(141,425)
3	153,250	11,825
4	96,110	107,935

Payback Period for Project A:

$$\text{Payback period}_A = \text{Years before cost recovery} + \frac{\text{Remaining cost to recover}}{\text{Cash flow during the year}}$$

$$= 3 \text{ years} + \frac{\$35{,}565}{\$145{,}655 \text{ per year}}$$

$$= 3.24 \text{ years}$$

Payback Period for Project B:

$$\text{Payback period}_B = \text{Years before cost recovery} + \frac{\text{Remaining cost to recover}}{\text{Cash flow during the year}}$$

$$= 2 \text{ years} + \frac{\$141{,}425}{\$153{,}250 \text{ per year}}$$

$$= 2.92 \text{ years}$$

If the payback period is three years, project B will be chosen. If the payback criterion is five years, both A and B will be chosen.

10.3 Evaluation of Terrell Corp. project:

	Year 1	Year 2	Year 3	Year 4	Year 5
Sales	$123,450	$176,875	$242,455	$255,440	$267,125
Expenses	137,410	126,488	141,289	143,112	133,556
Depreciation	23,450	23,450	23,450	23,450	23,450
EBIT	($ 37,410)	$ 26,937	$ 77,716	$ 88,878	$110,119
Taxes (34%)	12,719	9,159	26,423	30,219	37,440
Net Income	($ 24,691)	$ 17,778	$ 51,293	$ 58,659	$ 72,679
Beginning Book Value	117,250	93,800	70,350	46,900	23,450
Less: Depreciation	(23,450)	(23,450)	(23,450)	(23,450)	(23,450)
Ending Book Value	$ 93,800	$ 70,350	$ 46,900	$ 23,450	$ 0

$$\text{Average net income} = (-\$24{,}691 + \$17{,}778 + \$51{,}293 + \$58{,}659 + \$72{,}679)/5$$

$$= \$35{,}143.60$$

$$\text{Average book value} = (\$117{,}250 + \$93{,}800 + \$70{,}350 + \$46{,}900 + \$23{,}450 + \$0)/6$$

$$= \$58{,}625.00$$

$$\text{Accounting rate of return} = \$35{,}143.60/\$58{,}625.00$$

$$= 0.599, \text{ or } 59.9\%$$

The company should accept the project.

10.4 IRRs for two forklift systems:

Otis Forklifts:

First compute the IRR by the trial-and-error approach.

NPV (Otis) = \$337,075 > \$0

We should use a higher discount rate to get NPV = \$0.

At $k = 15$ percent:

$$\begin{aligned}\text{NPV}_{\text{Otis}} &= -\$3{,}123{,}450 + \frac{\$979{,}225}{1.15} + \frac{\$1{,}358{,}886}{(1.15)^2} + \frac{\$2{,}111{,}497}{(1.15)^3} \\ &= -\$3{,}123{,}450 + \$851{,}500 + \$1{,}027{,}513 + \$1{,}388{,}344 \\ &= \$143{,}907\end{aligned}$$

Try a higher rate. At $k = 17$ percent:

$$\begin{aligned}\text{NPV}_{\text{Otis}} &= -\$3{,}123{,}450 + \$836{,}944 + \$992{,}685 + \$1{,}318{,}357 \\ &= \$24{,}536\end{aligned}$$

Try a higher rate. At $k = 17.5$ percent:

$$\begin{aligned}\text{NPV}_{\text{Otis}} &= -\$3{,}123{,}450 + \$833{,}383 + \$984{,}254 + \$1{,}301{,}598 \\ &= -\$4{,}215\end{aligned}$$

Thus, the IRR for Otis is less than 17.5 percent. Using a financial calculator, you can find the exact rate to be 17.43 percent.

Craigmore Forklifts:

First compute the IRR using the trial-and-error approach.

NPV (Craigmore) = \$90,606 > \$0

We should use a higher discount rate to get NPV = \$0.

At $k = 15$ percent:

$$\begin{aligned}\text{NPV}_{\text{Craigmore}} &= -\$4{,}137{,}410 + \frac{\$875{,}236}{1.15} + \frac{\$1{,}765{,}225}{(1.12)^2} + \frac{\$2{,}865{,}110}{(1.12)^3} \\ &= -\$4{,}137{,}410 + \$761{,}075 + \$1{,}334{,}764 + \$1{,}883{,}856 \\ &= -\$157{,}715\end{aligned}$$

Try a lower rate. At $k = 13$ percent:

$$\begin{aligned}\text{NPV}_{\text{Craigmore}} &= -\$4{,}137{,}410 + \$774{,}545 + \$1{,}382{,}430 + \$1{,}985{,}665 \\ &= \$5{,}230\end{aligned}$$

Try a higher rate. At $k = 13.1$ percent:

$$\begin{aligned}\text{NPV}_{\text{Craigmore}} &= -\$4{,}137{,}410 + \$773{,}860 + \$1{,}379{,}987 + \$1{,}980{,}403 \\ &= -\$3{,}161\end{aligned}$$

Thus, the IRR for Craigmore is less than 13.1 percent. The exact rate is 13.06 percent. Based on the IRR, we would still choose the Otis system over the Craigmore system. The decision is the same as that indicated by NPV since both projects are conventional.

10.5 You can use Equation 10.6 to solve for the NPV:

$$\text{PI} = \frac{\text{NPV} + \text{Initial investment}}{\text{Initial investment}}$$

$$2.24 = \frac{\text{NPV} + \$1{,}000{,}000}{\$1{,}000{,}000}$$

Therefore:

$$\text{NPV} = \$1{,}240{,}000$$

Discussion Questions

10.1 Explain why the cost of capital is referred to as the "hurdle" rate in capital budgeting.

10.2 **a.** Sykes, Inc., management is considering two projects: a plant expansion and a new computer system for the firm's production department. Classify these projects as independent, mutually exclusive, or contingent projects and explain your reasoning.

b. A company is building a new plant on the outskirts of Smallesville. The town has offered to donate the land, and as part of the agreement, the company will have to build an access road from the main highway to the plant. How will the project of building the road be classified in the capital budgeting analysis?

c. Management of your firm is currently considering upgrading the operating systems of all the firm's computers. One alternative is to choose the Linux operating system that a local computer services firm has offered to install and maintain. Microsoft has also put in a bid to install the new Windows operating system for businesses. How would these projects be classified?

10.3 In the context of capital budgeting, what is "capital rationing"?

10.4 Provide two conditions under which a set of projects might be characterized as mutually exclusive.

10.5 **a.** A firm invests in a project that is expected to earn a return of 12 percent. If the appropriate cost of capital is also 12 percent, did the firm make the right decision? Explain.

b. What is the impact on the firm if it accepts a project with a negative NPV?

10.6 Identify the weaknesses of the payback period method.

10.7 What are the strengths and weaknesses of the accounting rate of return approach?

10.8 Under what circumstances might the IRR and NPV approaches produce conflicting results?

10.9 The modified IRR (MIRR) alleviates two concerns with using the IRR method for evaluating capital investments. What are they?

10.10 Elkridge Construction Company has an average cost of capital of 12 percent. This cost of capital reflects the cost of capital for an Elkridge Construction project with average risk. However, the firm takes on projects of various risk levels. The company's experience suggests that low-risk projects have a cost of capital of 10 percent and high-risk projects have a cost of capital of 15 percent. Which of the following projects should the company reject?

Project	Expected Return	Risk
1. Single-family homes	13%	Low
2. Multifamily residential	12	Average
3. Commercial	18	High
4. Single-family homes	9	Low
5. Commercial	13	High

10.11 High Tech Monopoly Co. has plenty of cash to fund any conceivable positive NPV project. Can you describe a situation in which capital rationing could still occur?

10.12 The profitability index is a tool for measuring a project's benefits relative to its costs. How might this help to eliminate bias in project selection?

Questions and Problems

Basic

10.1 **Net present value:** Riggs Corp. management is planning to spend $650,000 on a new marketing campaign. They believe that this action will result in additional cash flows of $325,000 over the next three years. If the discount rate is 17.5 percent, what is the NPV of this project?

10.2 **Net present value:** Kingston, Inc., management is considering purchasing a new machine at a cost of $4,133,250. They expect this equipment to produce cash flows of $814,322, $863,275, $937,250, $1,017,112, $1,212,960, and $1,225,000 over the next six years. If the appropriate discount rate is 15 percent, what is the NPV of this investment?

10.3 **Net present value:** Crescent Industries management is planning to replace some existing machinery in its plant. The cost of the new equipment and the resulting cash flows are shown in the accompanying table. If the firm uses an 18 percent discount rate for projects like this, should management go ahead with the project?

Year	Cash Flow
0	−$3,300,000
1	875,123
2	966,222
3	1,145,000
4	1,250,399
5	1,504,445

10.4 Net present value: Management of Franklin Mints, a confectioner, is considering purchasing a new jelly bean-making machine at a cost of $312,500. They project that the cash flows from this investment will be $121,450 for the next seven years. If the appropriate discount rate is 14 percent, what is the NPV for the project?

10.5 Net present value: Blanda Incorporated management is considering investing in two alternative production systems. The systems are mutually exclusive, and the cost of the new equipment and the resulting cash flows are shown in the accompanying table. If the fi rm uses a 9 percent discount rate for production system projects, in which system should the firm invest?

Year	System 1	System 2
0	−$15,000	−$45,000
1	15,000	32,000
2	15,000	32,000
3	15,000	32,000

10.6 Payback: Refer to Problem 10.5. What are the payback periods for Production Systems 1 and 2? If the systems are mutually exclusive and the firm always chooses projects with the lowest payback period, in which system should the firm invest?

10.7 Payback: Quebec, Inc., is purchasing machinery at a cost of $3,768,966. The company's management expects the machinery to produce cash flows of $979,225, $1,158,886, and $1,881,497 over the next three years, respectively. What is the payback period?

10.8 Payback: Northern Specialties just purchased inventory-management computer software at a cost of $1,645,276. Cost savings from the investment over the next six years will produce the following cash flow stream: $212,455, $292,333, $387,479, $516,345, $645,766, and $618,325. What is the payback period on this investment?

10.9 Payback: Nakamichi Bancorp has made an investment in banking software at a cost of $1,875,000. If management expects productivity gains and cost savings to generate additional cash flows of $586,212, $713,277, $431,199, and $318,697 over the next four years, what is the investment's payback period?

10.10 Average accounting rate of return (ARR): Capitol Corp. management is expecting a project to generate after-tax income of $63,435 in each of the next three years. The average book value of the project's equipment over that period will be $212,500. If the firm's investment decision on any project is based on an ARR of 37.5 percent, should this project be accepted?

10.11 Internal rate of return: Refer to Problem 10.4. What is the IRR that Franklin Mints management can expect on this project?

10.12 Internal rate of return: Hathaway, Inc., a resort management company, is refurbishing one of its hotels at a cost of $7.8 million. Management expects that this will lead to additional cash flows of $1.8 million for the next six years. What is the IRR of this project? If the appropriate cost of capital is 12 percent, should Hathaway go ahead with this project?

10.13 Profitability index: What is the profitability index, and why is it helpful in the capital rationing process?

Intermediate

10.14 Net present value: Champlain Corp. management is investigating two computer systems. The Alpha 8300 costs $3,122,300 and will generate cost savings of $1,345,500 in each of the next five years. The Beta 2100 system costs $3,750,000 and will produce cost savings of $1,125,000 in the first three years and then $2 million for the next two years. If the company's discount rate for similar projects is 14 percent, what is the NPV of each system? Which one should be chosen based on the NPV?

10.15 Net present value: Briarcrest Condiments is a spice-making firm. Recently, it developed a new process for producing spices. The process requires new machinery that would cost $1,968,450, have a life of five years, and would produce the cash flows shown in the following table. What is the NPV if the discount rate is 15.9 percent?

Year	Cash Flow
1	$512,496
2	−242,637
3	814,558
4	887,225
5	712,642

10.16 Net present value: Cranjet Industries is expanding its product line and its production capacity. The costs and expected cash flows of the two independent projects are given in the following table. The firm uses a discount rate of 16.4 percent for such projects.

a. What are the NPVs of the two projects?

b. Should both projects be accepted? or either? or neither? Explain your reasoning.

Year	Product Line Expansion	Production Capacity Expansion
0	−$2,575,000	−$8,137,250
1	600,000	2,500,000
2	875,000	2,500,000
3	875,000	2,500,000
4	875,000	3,250,000
5	875,000	3,250,000

10.17 Net present value: Emporia Mills management is evaluating two alternative heating systems. Costs and projected energy savings are given in the following table. The firm uses 11.5 percent to discount such project cash flows. Which system should be chosen?

Year	System 100	System 200
0	−$1,750,000	−$1735,000
1	275,223	750,000
2	512,445	612,500
3	648,997	550,112
4	875,000	384,226

10.18 Payback: Creative Solutions, Inc., has just invested $4,615,300 in new equipment. The firm uses a payback period criteria of rejecting any project that takes more than four years to recover its costs. Management anticipates cash flows of $644,386, $812,178, $943,279, $1,364,997, $2,616,300, and $2,225,375 over the next six years. Does this investment meet the firm's payback criteria?

10.19 Discounted payback: Timeline Manufacturing Co. management is evaluating two projects. The company uses payback criteria of three years or less. Project A has a cost of $912,855, and Project B's cost is $1,175,000. Cash flows from both projects are given in the following table. What are their discounted payback periods, and which will be accepted with a discount rate of 8 percent?

Year	Project A	Project B
1	$86,212	$586,212
2	313,562	413,277
3	427,594	231,199
4	285,552	

10.20 Payback: Regent Corp. management is evaluating three competing types of equipment. Costs and cash flow projections for all three are given in the following table. Which would be the best choice based on payback period?

Year	Type 1	Type 2	Type 2
0	−$1,311,450	−$1,415,888	−$1,612,856
1	212,566	586,212	786,212
2	269,825	413,277	175,000
3	455,112	331,199	175,000
4	285,552	141,442	175,000
5	121,396		175,000
6			175,000

10.21 Discounted payback: Nugent Communication Corp. is investing $9,365,000 in new technologies. The company's management expects significant benefits in the first three years after installation (as can be seen by the following cash flows) and smaller constant benefits in each of the next four years. What is the discounted payback period for the project assuming a discount rate of 10 percent?

	Year			
	1	2	3	4–7
Cash Flows	$2,265,433	$4,558,721	$3,378,911	$1,250,000

10.22 Modified internal rate of return (MIRR): Morningside Bakeries recently purchased equipment at a cost of $650,000. Management expects the equipment to generate cash flows of $275,000 in each of the next four years. The cost of capital is 14 percent. What is the MIRR for this project?

10.23 Modified internal rate of return (MIRR): Management of Sycamore Home Furnishings is considering acquiring a new machine that can create customized window treatments. The equipment will cost $263,400 and will generate cash flows of $85,000 over each of the next six years. If the cost of capital is 12 percent, what is the MIRR on this project?

10.24 Internal rate of return: Management of Great Flights, Inc., an aviation firm, is considering purchasing three aircraft for a total cost of $161 million. The company would lease the aircraft to an airline. Cash flows from the proposed leases are shown in the following table. What is the IRR of this project?

Year	Cash Flow
1–4	$23,500,000
5–7	72,000,000
8–10	80,000,000

10.25 Internal rate of return: Refer to Problem 10.5. Compute the IRR for both Production System 1 and Production System 2. Which has the higher IRR? Which production system has the higher NPV? Explain why the IRR and NPV rankings of Systems 1 and 2 are different.

10.26 Internal rate of return: Ancala Corporation management is considering investments in two new golf apparel lines for next season: golf hats and belts. Due to a funding constraint, these lines are mutually exclusive. A summary of each project's estimated cash flows over its three-year life, as well as the IRR and NPV of each, are outlined below. The CFO of the firm has decided to manufacture the belts; however, the CEO is questioning this decision given that the IRR is higher for manufacturing hats. Explain to the CEO why the IRRs and NPVs of the belt and hat projects disagree? Is the CFO's decision correct?

Year	Golf Belts	Golf Hats
0	−$1,000	−$500
1	1,000	500
2	500	300
3	500	300
NPV	$697.97	$427.87
IRR	54%	61%

10.27 Internal rate of return: Compute the IRR on the following cash flow streams:

a. An initial investment of $25,000 followed by a single cash flow of $37,450 in Year 6.

b. An initial investment of $1 million followed by a single cash flow of $1,650,000 in Year 4.

c. An initial investment of $2 million followed by cash flows of $1,650,000 and $1,250,000 in Years 2 and 4, respectively.

10.28 Internal rate of return: Compute the IRR for the following project cash flows:

a. An initial outlay of $3,125,000 followed by annual cash flows of $565,325 for the next eight years.

b. An initial investment of $33,750 followed by annual cash flows of $9,430 for the next five years.

c. An initial outlay of $10,000 followed by annual cash flows of $2,500 for the next seven years.

10.29 Profitability index: Suppose that you could invest in the following projects but have only $30,000 to invest. How would you make your decision and in which projects would you invest?

Project	Cost	NPV
A	$ 8,000	$4,000
B	11,000	7,000
C	9,000	5,000
D	7,000	4,000

10.30 Profitability index: Suppose that you could invest in the same projects as in the previous problem but have only $25,000 to invest. Which projects would you choose?

Advanced

10.31 Management of Draconian Measures, Inc., is evaluating two independent projects. The company uses a 13.8 percent discount rate for such projects. The costs and cash flows for the projects are shown in the following table. What are their NPVs?

Year	Project 1	Project 2
0	−$8,425,375	−$11,368,000
1	3,225,997	2,112,589
2	1,775,882	3,787,552
3	1,375,112	3,125,650
4	1,176,558	4,115,889
5	1,212,645	4,556,424
6	1,582,156	
7	1,365,882	

10.32 Refer to Problem 10.31.

a. What are the IRRs for the projects?

b. Does the IRR criterion suggest a different decision than the NPV criterion?

c. Explain how you would expect the management of Draconian Measures to decide which project(s) to invest in.

10.33 Management of Dravid, Inc., is currently evaluating three independent projects. The cost of funds can be either 13.6 percent or 14.8 percent depending on their financing plan. All three projects cost the same at $500,000. Expected cash flow streams are shown in the following table. Which projects would be accepted at a discount rate of 14.8 percent? What if the discount rate was 13.6 percent?

Year	Project 1	Project 2	Project 3
1	$ 0	$ 0	$245,125
2	125,000	$ 0	212,336
3	150,000	500,000	112,500
4	375,000	500,000	74,000

10.34 Management of Intrepid, Inc., is considering investing in three independent projects. The costs and the cash flows are given in the following table. The appropriate cost of capital is 14.5 percent. Compute the project IRRs and identify the projects that should be accepted.

Year	Project 1	Project 2	Project 3
0	−$275,000	−$312,500	−$500,000
1	63,000	153,250	212,000
2	85,000	167,500	212,000
3	85,000	112,000	212,000
4	100,000		212,000

10.35 Jekyll & Hyde Corp. management is evaluating two mutually exclusive projects. The cost of capital is 15 percent. Costs and cash flows for each project are given in the following table. Which project should be accepted?

Year	Project 1	Project 2
0	−$1,250,000	−$1,250,000
1	250,000	350,000
2	350,000	350,000
3	450,000	350,000
4	500,000	350,000
5	750,000	350,000

10.36 Management of Larsen Automotive, a manufacturer of auto parts, is considering investing in two projects. The company typically compares project returns to a cost of funds of 17 percent. Compute the IRRs based on the cash flows in the following table. Which project(s) will be accepted?

Year	Project 1	Project 2
0	−$475,000	−$500,000
1	300,000	117,500
2	110,000	181,300
3	125,000	244,112
4	140,000	278,955

10.37 Compute the IRR for each of the following projects:

Year	Project 1	Project 2	Project 3
0	−$10,000	−$10,000	−$10,000
1	4,750	1,650	800
2	3,300	3,890	1,200
3	3,600	5,100	2,875
4	2,100	2,750	3,400
5		800	6,600

10.38 Primus Corp. management is planning to convert an existing warehouse into a new plant that will increase its production capacity by 45 percent. The cost of this project will be $7,125,000. It will result in additional cash flows of $1,875,000 for the next eight years. The discount rate is 12 percent.

a. What is the payback period?

b. What is the NPV for this project?

c. What is the IRR?

10.39 Quasar Tech Co. management is investing $6 million in new machinery that will produce the next-generation routers. Sales to its customers will amount to $1,750,000 for the next three years and then increase to $2.4 million for three more years. The project is expected to last six years and operating costs, excluding depreciation, will be $898,620 annually. The machinery will be depreciated to a salvage value of $0 over six years using the straight-line method. The company's tax rate is 30 percent, and the cost of capital is 16 percent.

a. What is the payback period?

b. What is the average accounting return (ARR)?

c. Calculate the project NPV.

d. What is the IRR for the project?

10.40 Management of Skywards, Inc., an airline caterer, is purchasing refrigerated trucks at a total cost of $3.25 million. After-tax net income from this investment is expected to be $750,000 for the next five years. Annual depreciation expense will be $650,000. The cost of capital is 17 percent.

a. What is the discounted payback period?

b. Compute the ARR.

c. What is the NPV of this investment?

d. Calculate the IRR.

10.41 Trident Corp. management is evaluating two independent projects. The costs and expected cash flows are given in the following table. The cost of capital is 10 percent.

Year	Project A	Project B
0	−$312,500	−$395,000
1	121,450	153,552
2	121,450	158,711
3	121,450	166,220
4	121,450	132,000
5	121,450	122,000

a. Calculate the projects' NPV.

b. Calculate the projects' IRR.

c. Which project should be chosen based on NPV? Based on IRR? Is there a conflict?

d. If you are the decision maker for the firm, which project or projects will be accepted? Explain your reasoning.

10.42 Management of Tyler, Inc., is considering switching to a new production technology. The cost of the required equipment will be $4 million. The discount rate is 12 percent. The cash flows that management expects the new technology to generate are as follows.

Year	CF
1–2	0
3–5	$ 845,000
6–9	$1,450,000

a. Compute the payback and discounted payback periods for the project.

b. What is the NPV for the project? Should the firm go ahead with the project?

c. What is the IRR, and what would be the decision based on the IRR?

10.43 You are analyzing two proposed capital investments with the following cash flows:

Year	Project X	Project Y
0	−$20,000	−$20,000
1	13,000	7,000
2	6,000	7,000
3	6,000	7,000
4	2,000	7,000

The cost of capital for both projects is 10 percent. Calculate the profitability index (PI) for each project. Which project, or projects, should be accepted if you have unlimited funds to invest? Which project should be accepted if they are mutually exclusive?

CFA Problems

10.44 Given the following cash flows for a capital project, calculate the NPV and IRR. The required rate of return is 8 percent.

	Year					
	0	1	2	3	4	5
Cash Flow	−$50,000	$15,000	$15,000	$20,000	$10,000	$5,000

	NPV	IRR
a.	$1,905	10.9%
b.	$1,905	26.0%
c.	$3,379	10.9%
d.	$3,379	26.0%

10.45 Given the following cash flows for a capital project, calculate its payback period and discounted payback period. The required rate of return is 8 percent.

	Year					
	0	1	2	3	4	5
Cash Flow	−$50,000	$15,000	$15,000	$20,000	$10,000	$5,000

The discounted payback period is

a. 0.16 year longer than the payback period.

b. 0.80 year longer than the payback period.

c. 1.01 years longer than the payback period.

d. 1.85 years longer than the payback period.

10.46 An investment of $100 generates after-tax cash flows of $40 in Year 1, $80 in Year 2, and $120 in Year 3. The required rate of return is 20 percent. The net present value is closest to

a. $42.22 **b.** $58.33

c. $68.52 **d.** $98.95

10.47 An investment of $150,000 is expected to generate an after-tax cash flow of $100,000 in one year and another $120,000 in two years. The cost of capital is 10 percent. What is the internal rate of return?

a. 28.19 percent **b.** 28.39 percent

c. 28.59 percent **d.** 28.79 percent

10.48 An investment requires an outlay of $100 and produces after-tax cash flows of $40 annually for four years. A project enhancement increases the required outlay by $15 and the annual after-tax cash flows by $5. How will the enhancement affect the project's NPV profile? The vertical intercept of the NPV profile of the project shifts:

a. Up and the horizontal intercept shifts left.

b. Up and the horizontal intercept shifts right.

c. Down and the horizontal intercept shifts left.

d. Down and the horizontal intercept shifts right.

Sample Test Problems

10.1 Testco Corporation is considering adding a new product line. The cost of the factory and equipment to produce this product is $1,780,000. Company management expects net cash flows from the sale of this product to be $450,000 in each of the next eight years. If Testco uses a discount rate of 12 percent for projects like this, what is the net present value of this project? What is the internal rate of return?

10.2 Flowers Unlimited is considering purchasing an additional delivery truck that will have a seven-year useful life. The new truck will cost $42,000. Cost savings with this truck are expected to be $12,800 for the first two years, $8,900 for the following two years, and $5,000 for the last three years of the truck's useful life. What is the payback period for this project? What is the discounted payback period for this project with a discount rate of 10 percent?

10.3 What is the average accounting rate of return (ARR) on a piece of equipment that will cost $1.2 million and that will result in pretax cost savings of $380,000 for the first three years and then $280,000 for the following three years? Assume that the machinery will be depreciated to a salvage value of 0 over six years using the straight-line method and the company's tax rate is 32 percent. If the acceptance decision is based on the project exceeding an ARR of 20 percent, should this machinery be purchased?

10.4 What do we know about that project's IRR if we know that it has a positive NPV?

10.5 West Street Automotive is considering adding state safety inspections to its service offerings. The equipment necessary to perform these inspections will cost $557,000 and will generate cash flows of $195,000 over each of the next five years. If the cost of capital is 14 percent, what is the MIRR on this project?

10.6 You are chairperson of the investment committee at your firm. Five projects have been submitted to your committee for approval this month. The investment required and the project profitability index for each of these projects are presented in the following table:

Project	Investment	PI
A	$20,000	2.500
B	50,000	2.000
C	70,000	1.750
D	10,000	1.000
E	80,000	0.800

If you have $500,000 available for investments, which of these projects would you approve? Assume that you do not have to worry about having enough resources for future investments when making this decision.

$$FCF_{Project} = FCF_{Firm\ with\ project} - FCF_{Firm\ without\ project} \quad (11.1)$$

EXHIBIT 11.1 The Free Cash Flow Calculation for a Project

This exhibit shows how the incremental after-tax free cash flow (FCF) for a project is calculated. The FCF equals the change in the firm's cash income, excluding interest expense, that the project is responsible for, plus depreciation and amortization for the project, minus all required capital expenditures and investments in working capital. FCF also equals the incremental after-tax cash flow from operations minus the net capital expenditures and investments in working capital required for the project.

Explanation	Calculation	Formula
The change in the firm's cash income, excluding interest expense, resulting from the project	Revenue	Revenue
	−Cash operating expenses	−Op Ex
	Earnings before interest, taxes, depreciation, and amortization	EBITDA
	−Depreciation and amortization	−D&A
	Operating profit	EBIT
	×(1 − Firm's marginal tax rate)	×(1 − t)
	Net operating profit after tax	NOPAT
Adjustments for the impact of depreciation and amortization and investments on FCF	+Depreciation and amortization	+D&A
	Cash flow from operations	CF Opns
	−Capital expenditures	−Cap Exp
	−Additions to working capital	−Add WC
	=Free cash flow	=FCF

$$FCF = [(Revenue - Op\ Ex - D\&A) \times (1 - t)] + D\&A - Cap\ \ Exp - Add\ \ WC \quad (11.2)$$

Figure 11.1

$$CF\ Opns = [(Revenue - Op\ Ex - D\&A) \times (1 - t)] + D\&A$$

since Revenue − Op Ex = EBITDA, as shown in Exhibit 11.1, we can write:

$$\begin{aligned} CF\ Opns &= [(EBITDA - D\&A) \times (1 - t)] + D\&A \\ &= [(\$100.00 - \$50.00) \times (1 - 0.35)] + \$50.00 \\ &= \$82.50 \end{aligned}$$

EXHIBIT 11.2 **FCF Calculation Worksheet for the Performing Arts Center Project**

A free cash flow (FCF) calculation table is useful in evaluating a project. It helps organize the calculations and ensure that they are completed correctly.

	Year 0	Years 1 to 9	Year 10
Revenue			
−Op Ex			
EBITDA			
−D&A			
EBIT			
×(1 − *t*)			
NOPAT			
+D&A			
CF Opns			
−Cap Exp			
−Add WC			
=FCF			

EXHIBIT 11.3 **Completed FCF Calculation Worksheet for the Performing Arts Center Project**

The completed calculation table shows how the incremental after-tax free cash flows (FCF) for the performing arts center project are computed, along with the NPV for that project when the cost of capital is 10 percent.

	Year 0	Years 1 to 9	Year 10
Revenue		$14,100,000	$14,100,000
−Op Ex		8,460,000	8,460,000
EBITDA		$ 5,640,000	$ 5,640,000
−D&A		1,000,000	1,000,000
EBIT		$ 4,640,000	$ 4,640,000
×(1 − *t*)		0.70	0.70
NOPAT		$ 3,248,000	$ 3,248,000
+D&A		1,000,000	1,000,000
CF Opns		$ 4,248,000	$ 4,248,000
−Cap Exp	$10,000,000	0	0
−Add WC	1,000,000	0	−1000,000
=FCF	−$11,000,000	$ 4,248,000	$ 5,248,000
NPV @ 10%	$15,487,664		

Using Excel

Performing Arts Center Project

Cash flow calculations for capital budgeting problems are best set up and solved using a spreadsheet program. Here is the setup for the performing arts center project:

	A	B	D	F	H	J	L	N	P	R	T	V
1	**Key Assumptions:**											
2	Life of the project (Years)	10										
3	Number of new boxes	4										
4	Annual incremental revenue per box	$400,000										
5	Number of new seats	5,000										
6	Annual incremental revenue per seat	$2,500										
7	Incremental expense (% of revenue)	60%										
8	Construction cost (Cap Exp)*	$10,000										
9	Depreciation (per year)*	$1,000										
10	Additional investment in Year 0 (Add WC)*	$1,000										
11	WC to be recovered in Year 10*	($1,000)										
12	Tax rate	30%										
13	Cost of capital	10%										
14	Note: * denotes figures in thousands of dollars											
15												
16	**Cash Flow Calculations for Performing Arts Center Project ($ thousands)**											
17						Year						
18		0	1	2	3	4	5	6	7	8	9	10
19	Revenue		$14,100	$14,100	$14,100	$14,100	$14,100	$14,100	$14,100	$14,100	$14,100	$14,100
20	Operating Expenses		8,460	8,460	8,460	8,460	8,460	8,460	8,460	8,460	8,460	8,460
21	EBITDA		$5,640	$5,640	$5,640	$5,640	$5,640	$5,640	$5,640	$5,640	$5,640	$5,640
22	Less: Depreciation & Amortization		1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
23	EBIT		$4,640	$4,640	$4,640	$4,640	$4,640	$4,640	$4,640	$4,640	$4,640	$4,640
24	Less Taxes		1,392	1,392	1,392	1,392	1,392	1,392	1,392	1,392	1,392	1,392
25	NOPAT		$3,248	$3,248	$3,248	$3,248	$3,248	$3,248	$3,248	$3,248	$3,248	$3,248
26												
27	Plus: Depreciation & Amortization		1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
28	Cash Flows from Operations		$4,248	$4,248	$4,248	$4,248	$4,248	$4,248	$4,248	$4,248	$4,248	$4,248
29	Less: Capital Expenditures	$10,000	0	0	0	0	0	0	0	0	0	0
30	Less: Changes in Working Capital	$1,000	0	0	0	0	0	0	0	0	0	($1,000)
31												
32	**Free Cash Flow**	($11,000)	**$4,248**	**$4,248**	**$4,248**	**$4,248**	**$4,248**	**$4,248**	**$4,248**	**$4,248**	**$4,248**	**$5,248**
33												
34	**NPV**	**$15,488**										
35												

The following is the formula setup for the performing arts center project. As we did in Exhibit 11.3, we have combined Years 1 through 9 in a single column to save space. As mentioned in previous chapters, notice that none of the values in the actual worksheet are hard coded but instead use references from the key assumptions list, or specific formulas. This allows for an easy analysis of the impact of changes in the assumptions.

	A	B	C	D	E	V
1	**Key Assumptions:**					
2	Life of the project (Years)	10				
3	Number of new boxes	4				
4	Annual incremental revenue per box	400000				
5	Number of new seats	5000				
6	Annual incremental revenue per seat	2500				
7	Incremental expense (% of revenue)	0.6				
8	Construction cost (Cap Exp)*	10000				
9	Depreciation (per year)*	=B8/B2				
10	Additional investment in Year 0 (Add WC)*	1000				
11	WC to be recovered in Year 10*	(1000)				
12	Tax rate	0.3				
13	Cost of capital	0.1				
14	Note: * denotes figures in millions of dollars					
15						
16	**Cash Flow Calculations for Performing Arts Center Project** ($ thousands)					
17				Year		
18		0		1-9		10
19	Revenue			=($B$3*$B$4+$B$5*$B$6)/1000		=($B$3*$B$4+$B$5*$B$6)/1000
20	Operating Expenses			=$B$7*D19		=$B$7*V19
21	EBITDA			=D19-D20		=V19-V20
22	Less: Depreciation & Amortization			=$B$9		=$B$9
23	EBIT			=D21-D22		=V21-V22
24	Less Taxes			=D23*$B$12		=V23*$B$12
25	NOPAT			=D23-D24		=V23-V24
26						
27	Plus: Depreciation & Amortization			=$B$9		=$B$9
28	Cash Flows from Operations			=D25+D27		=V25+V27
29	Less: Capital Expenditures	=B8		0		0
30	Less: Changes in Working Capital	=B10		0		=B11
31						
32	**Free Cash Flow**	**=B28-B29-B30**		**=D28-D29-D30**		**=V28-V29-V30**
33						
34	**NPV**	**=NPV(B13, D32:V32)+B32**				
35						

DECISION MAKING

EXAMPLE 11.1 | Free Cash Flows

Situation You have saved $6,000 and plan to use $5,500 to buy a motorcycle. However, just before you go visit the motorcycle dealer, a friend of yours asks you to invest your $6,000 in a local pizza delivery business he is starting. Assuming he can raise the money, your friend has two alternatives regarding how to market the business. As illustrated below, both of these alternatives have an NPV of $2,614 with an opportunity cost of capital of 12 percent. You will receive all free cash flows from the business until you have recovered your $6,000 plus 12 percent interest. After that, you and your friend will split any additional cash proceeds. If you decide to invest, which alternative would you prefer that your friend choose?

	Alternative 1			Alternative 2		
	Year 0	Year 1	Year 2	Year 0	Year 1	Year 2
Revenue		$12,000	$12,000		$16,000	$8,000
−Op Ex		4,000	6,000		8,000	4,240
EBITDA		$ 8,000	$ 6,000		$ 8,000	$3,760
−D&A		2,500	2,500		2,500	2,500
EBIT		$ 5,500	$ 3,500		$ 5,500	$1,260
×(1 − *t*)		0.75	0.75		0.75	0.75
NOPAT		$ 4,125	$ 2,625		$ 4,125	$ 945
+D&A		2,500	2,500		2,500	2,500
CF Opns		$ 6,625	$ 5,125		$ 6,625	$3,445
−Cap Exp	$5,000	2,000	500	$5,000	500	500
−Add WC	1,000		(1,000)	1,000		(1,000)
=FCF	−$6,000	$ 4,625	$ 5,625	−$6,000	$ 6,125	$3,945
NPV @ 10%	$2,614			$2,614		

Decision If you expect no cash from other sources during the next year, you should insist that your friend choose Alternative 2. This is the only alternative that will produce enough FCF next year to purchase the motorcycle. Alternative 1 will produce $6,625 in CF Opns but will require $2,000 in capital expenditures. You will not be able to take more than $4,625 from the business in Year 1 under Alternative 1 without leaving the business short of cash.

EXHIBIT 11.4 **Adjusted FCF Calculations and NPV for the Performing Arts Center Project**

The adjustments described in the text result in changes in the FCF calculations and a different NPV for the performing arts center project.

	Year 0	Years 1 to 9	Year 10
Revenue		$13,500,000	$13,500,000
−Op Ex		8,100,000	8,100,000
−New salesperson's salary		75,000	75,000
−Lost cinema EBIT		500,000	500,000
EBITDA		$ 4,825,000	$ 4,825,000
−D&A		1,000,000	1,000,000
EBIT		$ 3,825,000	$ 3,825,000
×(1 − *t*)		0.70	0.70
NOPAT		$ 2,677,500	$ 2,677,500
+D&A		1,000,000	1,000,000
CF Opns		$ 3,677,500	$ 3,677,500
−Cap Exp	$10,000,000	0	0
−Add WC	1,000,000	0	−1,000,000
=FCF	−$11,000,000	$ 3,677,500	$ 4,677,500
NPV @ 10%	$11,982,189		

LEARNING BY DOING

APPLICATION 11.1 | Using the General Rules for FCF Calculations

Problem You have owned and operated a pizza parlor for several years. The space that you lease for your pizza parlor is considerably larger than the space you need. To more efficiently utilize this space, you are considering subdividing it and opening a hamburger joint. You know that your analysis should consider the overall impact of the hamburger project on the total cash flows of your business, but beyond estimating revenues and costs from hamburger-related sales and the investment required to get the hamburger business started, you are unsure what else you should consider. Based on the five general rules for incremental after-tax cash flow calculations, what other factors should you consider?

Approach Careful consideration of each of the five rules provides insights concerning the other factors that should be considered.

Solution Rule 1 suggests that you should only consider the incremental impact of the hamburger stand on actual overhead expenses, such as the cost of additional accounting support. Rule 2 indicates that you should consider the potential for the hamburger business to take sales away from (or cannibalize) the pizza business. Rule 3 suggests that you should carefully consider the opportunity cost associated with the excess space or any excess equipment that might be used for the hamburger business. If you could lease the extra space to someone else, for example, then the amount that you could receive by doing so is an opportunity cost and should be included in the analysis. Similarly, the price for which any excess equipment could be sold represents an opportunity cost. Rule 4 reminds you to consider cash flows from this point forward only. Forget sunk costs. Finally, Rule 5 tells you not to forget to account for the impact of taxes in your cash flow calculations.

$$1 + k = (1 + \Delta P_e) \times (1 + r) \tag{11.3}$$

Figure 11.2

$$r = \frac{1 + k}{1 + \Delta P_e} - 1$$

Figure 11.3

Year 0	Year 1	Year 2	Year 3	Year 4
−$50,000	$\frac{\$20{,}000}{1 + 0.05}$	$\frac{\$20{,}000}{(1 + 0.05)^2}$	$\frac{\$20{,}000}{(1 + 0.05)^3}$	$\frac{\$20{,}000}{(1 + 0.05)^4}$
= −$50,000	= $19,048	= $18,141	= $17,277	= $16,454

LEARNING BY DOING

APPLICATION 11.2 | The Investment Decision and Nominal versus Real Dollars

Problem You are trying to decide how to invest $25,000, which you just inherited from a distant relative. You do not want to take any risks with this money because you want to use it as a down payment on a home when you graduate in three years. Therefore, you have decided to invest the money in securities that are guaranteed by the U.S. government. You are considering two alternatives: a three-year Treasury note and an inflation-indexed Treasury security. If you invest in the three-year Treasury note, you will be paid 3 percent per year in interest and will get your $25,000 back at the end of three years. If you invest in the inflation-indexed security, you will be paid 1 percent per year plus an amount that reflects actual inflation in each of the next three years. For example, if inflation equals 2 percent per year for each of the next three years, you will receive 3 percent each year in total interest. This interest on the inflation-indexed security will compound, and you will receive a single payment at the end of three years. If you expect inflation to average 2.5 percent per year over the next three years, should you invest in the three-year Treasury note or in the inflation-indexed Treasury security?

Approach Compare the 3 percent return on the three-year Treasury note, which is a nominal rate of return, with the nominal rate of return that you can expect to receive from the inflation-indexed security and invest in the security with the highest rate. The nominal rate on the inflation-indexed security in each year equals the real rate of 1 percent plus the rate of inflation.

Solution Without doing any detailed calculations, it is apparent that you should invest in the inflation-indexed security. The reason is that if the rate of inflation turns out to be 2.5 percent, the inflation-indexed security will yield 3.5 percent (1 percent plus the 2.5 percent inflation adjustment) per year. With this investment, the real purchasing power of your money will increase by 1 percent per year. This will be true regardless of what inflation turns out to be during the three-year period. Assuming that you can reinvest the annual interest payments from the three-year Treasury note at 3 percent, if you buy this security, the real purchasing power of your money will increase by only 0.5 percent (3 percent interest rate less 2.5 percent inflation) per year.

EXHIBIT 11.5 U.S. Tax Rate Schedule for a Single Individual in 2016

The income tax system for individuals in the United States is progressive in that the tax rate increases with income. For very low income levels—say, $20,000 per year—individuals pay only 15 percent on each additional dollar they earn. For individuals who earn more than $415,050, this rate is 39.6 percent.

Taxable Income		
More Than	But Not More Than	Tax Owed
$0	$9,275	10% of amount beyond $0
$9,275	$37,650	$927.50 + 15% of amount beyond $9,275
$37,650	$91,150	$5,183.75 + 25% of amount beyond $37,650
$91,150	$190,150	$18,558.75 + 28% of amount beyond $91,150
$190,150	$413,350	$46,278.75 + 33% of amount beyond $190,150
$413,350	$415,050	$119,934.75 + 35% of amount beyond $413,350
$415,050	no limit	$120,529.75 + 39.6% of amount beyond $415,050

EXHIBIT 11.6 **U.S. Corporate Tax Rate Schedule in 2016**

Just like the tax system for individuals, the tax system for corporations in the United States is progressive, with marginal tax rates ranging from 15 percent to as high as 39 percent.

Taxable Income		
More Than	But Not More Than	Tax Owed
$0	$50,000	15% of amount beyond $0
$50,000	$75,000	$7,500 + 25% of amount beyond $50,000
$75,000	$100,000	$13,750 + 34% of amount beyond $75,000
$100,000	$335,000	$22,250 + 39% of amount beyond $100,000
$335,000	$10,000,000	$113,900 + 34% of amount beyond $335,000
$10,000,000	$15,000,000	$3,400,000 + 35% of amount beyond $10,000,000
$15,000,000	$18,333,333	$5,150,000 + 38% of amount beyond $15,000,000
$18,333,333	———	35% on all income

LEARNING BY DOING

APPLICATION 11.3 | Calculating Marginal and Average Tax Rates

Problem Assume that you are operating the pizza parlor and hamburger joint described in Learning by Doing Application 11.1. Because the business has become complicated, you have incorporated. From now on, earnings are subject to the corporate tax rates presented in Exhibit 11.6. If your corporation's total taxable income is $200,000 in 2016, how much does it owe in federal taxes? What are the corporation's marginal and average federal tax rates? If you were considering buying a new oven, which tax rate would you use when computing the free cash flows?

Approach Use the rates presented in Exhibit 11.6 to calculate the total amount that your corporation owes. The marginal federal tax rate is the rate in the "Tax Owed" column in Exhibit 11.6 that corresponds to the row in which the total taxable income earned by your restaurant is found. The ratio of the total amount that you owe divided by your total taxable income equals the average federal tax rate. You would use the tax rate that would be applied to the incremental after-tax free cash flows associated with the new oven.

Solution From Exhibit 11.6, you can see that with a taxable income of $200,000, your corporation will owe taxes of $22,250 + ($100,000 × 0.39) = $61,250. The marginal tax rate is 39 percent, and the average tax rate is $61,250/$200,000 = 0.306, or 30.6 percent. You will use the marginal rate of 39 percent when computing the free cash flows for the new oven.

EXHIBIT 11.7 **MACRS Depreciation Schedules by Allowable Recovery Period**

The MACRS schedule lists the tax depreciation rates that firms use for assets placed into service after the Tax Reform Act of 1986 went into effect. The table indicates the percentage of the cost of the asset that can be depreciated in each year during the period that it is being used. Year 1 is the year in which the asset is first placed into service.

Year	3-Year	5-Year	7-Year	10-Year	15-Year	20-Year
1	33.33%	20.00%	14.29%	10.00%	5.00%	3.75%
2	44.45	32.00	24.49	18.00	9.50	7.22
3	14.81	19.20	17.49	14.40	8.55	6.68
4	7.41	11.52	12.49	11.52	7.70	6.18
5		11.52	8.93	9.22	6.93	5.71
6		5.76	8.92	7.37	6.23	5.29
7			8.93	6.55	5.90	4.89
8			4.46	6.56	5.90	4.52
9				6.55	5.91	4.46
10				3.28	5.90	4.46
11					5.91	4.46
12					5.90	4.46
13					5.91	4.46
14					5.90	4.46
15					5.91	4.46
16					2.95	4.46
17						4.46
18						4.46
19						4.46
20						4.46
21						2.24
Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

$$\text{Add WC} = \text{Change in cash and cash equivalents} + \text{Change in accounts receivable} + \text{Change in inventories} - \text{Change in accounts payable} \quad (11.4)$$

EXHIBIT 11.8 **MACRS Depreciation Calculations for the Performing Arts Center Project ($ thousands)**

Using the percentages from the 10-Year MACRS depreciation schedule in Exhibit 11.7, we can calculate the tax (MACRS) depreciation for each year during the life of the performing arts center project.

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Depreciation Calculations										
Beginning book value	$10,000	$9,000	$7,200	$5,760	$4,608	$3,686	$2,949	$2,294	$1,639	$983
MACRS percentage	10.00%	18.00%	14.40%	11.52%	9.22%	7.37%	6.55%	6.55%	6.56%	6.55%
MACRS depreciation	$1,000	$1,800	$1,440	$1,152	$922	$737	$655	$655	$656	$655
Ending book value	$9,000	$7,200	$5,760	$4,608	$3,686	$2,949	$2,294	$1,639	$983	$328

EXHIBIT 11.9 **FCF Calculations and NPV for Performing Arts Center Project with MACRS Depreciation ($ thousands)**

This exhibit shows the FCF calculations and the NPV for the performing arts center project when MACRS is used to compute depreciation. These calculations correspond to those in Exhibit 11.3, which reflect straight-line depreciation. Notice that the NPV is greater with the MACRS system because the tax shields from the depreciation are realized sooner.

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Revenue		$14,100	$14,100	$14,100	$14,100	$14,100	$14,100	$14,100	$14,100	$14,100	$14,100
−Op Ex		8,460	8,460	8,460	8,460	8,460	8,460	8,460	8,460	8,460	8,460
EBITDA		$ 5,640	$ 5,640	$ 5,640	$ 5,640	$ 5,640	$ 5,640	$ 5,640	$ 5,640	$ 5,640	$ 5,640
−D&A		1,000	1,800	1,440	1,152	922	737	655	655	656	655
EBIT		$ 4,640	$ 3,840	$ 4,200	$ 4,488	$ 4,718	$ 4,903	$ 4,985	$ 4,985	$ 4,984	$ 4,985
×(1 − *t*)		0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
NOPAT		$ 3,248	$ 2,688	$ 2,940	$ 3,142	$ 3,303	$ 3,432	$ 3,490	$ 3,490	$ 3,489	$ 3,490
+D&A		1,000	1,800	1,440	1,152	922	737	655	655	656	655
CF Opns		$ 4,248	$ 4,488	$ 4,380	$ 4,294	$ 4,225	$ 4,169	$ 4,145	$ 4,145	$ 4,145	$ 4,145
−Cap Exp	$10,000	0	0	0	0	0	0	0	0	0	−98
−Add WC	1,000	0	0	0	0	0	0	0	0	0	−1,000
=FCF	−$11,000	$ 4,248	$ 4,488	$ 4,380	$ 4,294	$ 4,225	$ 4,169	$ 4,145	$ 4,145	$ 4,145	$ 5,243
NPV @ 10%	$15,610										

EXHIBIT 11.10 **FCF Calculations and NPV for the Performing Arts Center Project with a $1 Million Salvage Value in Year 10 ($ thousands)**

This exhibit shows the FCF calculations and NPV for the performing arts center project assuming that the salvage value of the $10 million capital investment is $1 million in Year 10. All other assumptions are the same as in Exhibit 11.9.

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
CF Opns		$4,248	$4,488	$4,380	$4,294	$4,225	$4,169	$4,145	$4,145	$4,145	$4,145
−Cap Exp	$10,000	0	0	0	0	0	0	0	0	0	−798
−Add WC	1,000	0	0	0	0	0	0	0	0	0	−1,000
=FCF	−$11,000	$4,248	$4,488	$4,380	$4,294	$4,225	$4,169	$4,145	$4,145	$4,145	$5,943
NPV @ 10%	$15,880										

LEARNING BY DOING

APPLICATION 11.4 | Accounting for Taxes When Assets Are Sold

Problem You have decided to replace an oven in your pizza parlor. The old oven originally cost $20,000. Depreciation charges of $15,000 have been taken since you acquired it, resulting in a current book value of $5,000. The owner of a restaurant down the street has offered you $3,000 for the old oven. If you accept this offer, how will the sale affect the cash flows from your business? Assume the marginal tax rate for your business is 39 percent.

Approach First use the general formula presented above to calculate the tax on the salvage value. Then subtract (add) any tax obligation (savings) from (to) the amount that you will receive for the oven to obtain the total impact of the sale on the cash flows to your business.

Solution If you sell the old oven, you will receive a cash inflow of $3,000 from the purchaser in return for an asset with a book value of $5,000. With a 39 percent marginal tax rate, this will result in a tax of:

$$\text{Tax on sale of an asset} = (\text{Selling price of asset} - \text{Book value of asset}) \times t$$
$$= (\$3{,}000 - \$5{,}000) \times 0.39 = -\$780$$

Since you are selling the oven for less than its book value, you will realize a tax savings of $780. Therefore, the total impact of the sale on the cash flows from your business will be $3,000 + $780 = $3,780. Of course, the purchase price of the new oven will probably more than offset this amount.

Note that if the sale price exceeded the book value of the oven by $2,000, you would have a taxable gain and would have to pay $780. In this case, the cash flows received from the purchaser would be reduced, rather than increased, by $780.

EXHIBIT 11.11 **Expected FCFs for New Board Game ($ thousands)**

The expected FCF for each year during the life of the board game project equals the weighted average of the possible FCFs in that year.

		Year			
Outcome	Probability	0	1	2	3
Game is very successful	0.25	−$100	$70	$90	$60
Game sales are acceptable	0.50	−100	50	55	40
Game sales are poor	0.25	−100	25	15	0
Expected FCF		−$100.00	$48.75	$53.75	$35.00

Figure 11.4

$$\text{NPV} = \text{FCF}_0 + \frac{\text{FCF}_1}{1+k} + \frac{\text{FCF}_2}{(1+k)^2} + \cdots + \frac{\text{FCF}_n}{(1+k)^n}$$

$$\text{NPV}_\text{A} = -\$250 + \frac{-\$0}{1.10} + \frac{-\$250}{(1.10)^2} + \frac{-\$0}{(1.10)^3} + \frac{-\$250}{(1.10)^4} + \frac{-\$0}{(1.10)^5} + \frac{-\$0}{(1.10)^6}$$

$$= -\$627.36$$

$$\text{NPV}_\text{B} = -\$360 + \frac{-\$0}{1.10} + \frac{-\$0}{(1.10)^2} + \frac{-\$360}{(1.10)^3} + \frac{-\$0}{(1.10)^4} + \frac{-\$0}{(1.10)^5} + \frac{-\$0}{(1.10)^6}$$

$$= -\$630.47$$

$$\text{EAC}_i = k\,\text{NPV}_i\left[\frac{(1+k)^t}{(1+k)^t - 1}\right] \tag{11.5}$$

Figure 11.5

$$\text{EAC}_\text{A} = (0.1)(-\$250)\left[\frac{(1+0.1)^2}{(1+0.1)^2 - 1}\right] = -\$144.05$$

and

$$\text{EAC}_\text{B} = (0.1)(-\$360)\left[\frac{(1+0.1)^3}{(1+0.1)^3 - 1}\right] = -\$144.76$$

Figure 11.6

$$\text{NPV}_\text{A} = -\$250 + \frac{-\$50}{1.10} + \frac{-\$50}{(1.10)^2} = -\$336.78$$

$$\text{NPV}_\text{B} = -\$360 + \frac{-\$55}{1.10} + \frac{-\$55}{(1.10)^2} + \frac{-\$55}{(1.10)^3} = -\$496.78$$

Figure 11.7

$$EAC_A = (0.1)(-\$336.78)\left[\frac{(1+0.1)^2}{(1+0.1)^2-1}\right] = -\$194.05$$

and

$$EAC_B = (0.1)(-\$496.78)\left[\frac{(1+0.1)^3}{(1+0.1)^3-1}\right] = -\$199.76$$

LEARNING BY DOING

APPLICATION 11.5 | Using EAC to Compare Projects with Different Lives

Problem You are looking at new ovens for your pizza parlor, and you see two models that would work equally well. Model A would cost $40,000 and last 10 years. Model B would cost $50,000 but would last 12 years and would require $500 less electricity per year than model A. Which model is less expensive? Assume a 10 percent opportunity cost of capital.

Approach Use the EAC formula, Equation 11.5, to calculate the EAC of the initial investment for each model of oven. Add the annual electricity savings to the EAC of the initial investment for Model B. Choose the model with the smaller total EAC.

Solution The EACs for the initial investments in the two ovens are as follows:

$$EAC_A = (0.1)(-\$40{,}000)\left[\frac{(1+0.1)^{10}}{(1+0.1)^{10}-1}\right] = -\$6{,}509.82$$

$$EAC_B = (0.1)(-\$50{,}000)\left[\frac{(1+0.1)^{12}}{(1+0.1)^{12}-1}\right] = -\$7{,}338.17$$

Now since the electricity savings would be $500 per year in nominal dollars, we can simply add this amount to the EAC calculated for Model B above to get the true $EAC_B = -\$7{,}338.16 + \$500 = -\$6{,}838.16$. Since the EAC for Model B is still more negative than that for Model A, we would conclude that Model A would be less expensive over its expected useful life.

EXAMPLE 11.2 | Deciding When to Replace an Asset

DECISION MAKING

Situation You are trying to decide when to replace your car. It is already five years old, and maintenance costs keep increasing each year as more and more parts wear out and need to be replaced. You do not really care whether or not your car is new. You just want a car that gets you around at the lowest cost. You expect maintenance costs for your car over the next five years to increase by $500 per year from $500 this past year. Your car will be worthless in five years. As an alternative, you can buy a new car with a five-year warranty that will cover all maintenance costs. The new car will cost $15,000, and you expect to be able to sell it for $10,000 in five years. The gas mileage for both cars is the same. Remembering what you learned in corporate finance, you calculate the EAC for each option using a 10 percent opportunity cost of capital. The NPV for your old car is:

$$\begin{aligned} \text{NPV}_{\text{Old car}} &= \frac{-\$1{,}000}{1.1} + \frac{-\$1{,}500}{(1.1)^2} + \frac{-\$2{,}000}{(1.1)^3} + \frac{-\$2{,}500}{(1.1)^4} + \frac{-\$3{,}000}{(1.1)^5} \\ &= -\$7{,}221.69 \end{aligned}$$

and the EAC is −$1,905.06. The NPV for the new car is:

$$\begin{aligned} \text{NPV}_{\text{New car}} &= -\$15{,}000 + \frac{\$10{,}000}{(1.1)^5} \\ &= -\$8{,}790.79 \end{aligned}$$

and the EAC is −$2,318.99. When should you replace your old car?

Decision The EAC for the new car is more negative than the EAC for your old car, suggesting that you should not replace your old car. However, if you compare the EAC for the new car with the annual maintenance costs you expect for your old car, you will see that the annual maintenance costs rise above the EAC of the new car in Year 4. Assuming that the economics of the new car remain the same, you should replace your car after Year 3.

Figure 11.8

$$\begin{aligned} \text{NPV}_{10} &= \$35{,}000 \\ \text{NPV}_{11} &= \$40{,}250 \\ \text{NPV}_{12} &= \$45{,}483 \\ \text{NPV}_{13} &= \$49{,}576 \\ \text{NPV}_{14} &= \$52{,}550 \end{aligned}$$

Figure 11.9

$$\begin{aligned} \text{NPV}_{10,\,10} &= \$35{,}000 \\ \text{NPV}_{10,\,11} &= \$40{,}250/1.1 = \$36{,}591 \\ \text{NPV}_{10,\,12} &= \$45{,}483/(1.1)^2 = \$37{,}589 \\ \text{NPV}_{10,\,13} &= \$49{,}576/(1.1)^3 = \$37{,}247 \\ \text{NPV}_{10,\,14} &= \$52{,}550/(1.1)^4 = \$35{,}892 \end{aligned}$$

Summary of Key Equations

Equation	Description	Formula
11.1	Incremental free cash flow definition	$FCF_{Project} = FCF_{Firm\ with\ project} - FCF_{Firm\ without\ project}$
11.2	Incremental free cash flow calculation	$FCF = [(Revenue - Op\ Ex - D\&A) \times (1 - t)] + D\&A - Cap\ Exp - Add\ WC$
11.3	Inflation and real components of cost of capital	$1 + k = (1 + \Delta P_e) \times (1 + r)$
11.4	Incremental additions to working capital	Add WC = Change in cash and cash equivalents + Change in accounts receivable + Change in inventories − Change in accounts payable
11.5	Equivalent annual cost	$EAC_i = k\ NPV_i \left[\frac{(1+k)^t}{(1+k)^t - 1}\right]$

Self-Study Problems

11.1 Explain why the announcement of a new investment is usually accompanied by a change in the firm's stock price.

11.2 In calculating the NPV of a project, should we use all of the after-tax cash flows associated with the project or incremental after-tax free cash flows from the project? Why?

11.3 You are considering opening another restaurant in the TexasBurgers chain. The new restaurant will have annual revenue of $300,000 and operating expenses of $150,000. The annual depreciation and amortization for the assets used in the restaurant will equal $50,000. An annual capital expenditure of $10,000 will be required to offset wear and tear on the assets used in the restaurant, but no additions to working capital will be required. The marginal tax rate will be 40 percent. Calculate the incremental annual after-tax free cash flow for the project.

11.4 Sunglass Heaven, Inc., is launching a new store in a shopping mall in Houston. The annual revenue of the store depends on the weather conditions in the summer in Houston. The annual revenue will be $240,000 in a sizzling summer with a probability of 0.3, $80,000 in a cool summer with a probability of 0.2, and $150,000 in a normal summer with a probability of 0.5. What is the expected annual revenue for the store?

11.5 Sprigg Lane Manufacturing, Inc., needs to purchase a new central air-conditioning system for a plant. There are two choices. The first system costs $50,000 and is expected to last 10 years, and the second system costs $72,000 and is expected to last 15 years. Assume that the opportunity cost of capital is 10 percent. Which air-conditioning system should Sprigg Lane purchase?

Solutions to Self-Study Problems

11.1 A firm's investments cause changes in its future after-tax free cash flows, and stockholders are the residual claimants (owners) of those cash flows. Therefore, the stock price should increase when stockholders expect an investment to have a positive NPV and decrease when they expect it to have a negative NPV.

11.2 We should use incremental after-tax free cash flows from the project. Incremental after-tax free cash flows reflect the amount by which the firm's total cash flows will change if the project is adopted. In other words, they represent the net difference in cash revenues, costs, taxes, and investment outlays (for net working capital and capital expenditures) at the firm level with and without the project, which is precisely what the stockholders care about.

11.3 The incremental annual after-tax free cash flow is calculated as follows:

$$\text{FCF} = [(\$300{,}000 - \$150{,}000 - \$50{,}000) \times (1 - 0.4)] + \$50{,}000 - \$10{,}000 = \$100{,}000$$

11.4 The expected annual revenue is:

$$\text{E(Revenue)} = (0.3 \times \$240{,}000) + (0.2 \times \$80{,}000) + (0.5 \times \$150{,}000) = \$163{,}000$$

11.5 The equivalent annual cost for each system is as follows:

$$\text{EAC}_1 = (0.1)(\$50{,}000)\left[\frac{(1.1)^{10}}{(1.1)^{10} - 1)}\right] = \$8{,}137.27$$

$$\text{EAC}_2 = (0.1)(\$72{,}000)\left[\frac{(1.1)^{15}}{(1.1)^{15} - 1)}\right] = \$9{,}466.11$$

Therefore, Sprigg Lane should purchase the first system.

Discussion Questions

11.1 Do you agree or disagree with the following statement given the discussion in this chapter? We can calculate future cash flows precisely and obtain an exact value for the NPV of an investment.

11.2 What are the differences between cash flows used in capital budgeting calculations and past accounting earnings?

11.3 Suppose that FRA Corporation already has divisions in both Dallas and Houston. FRA is now considering setting up a third division in Austin. This expansion will require that one senior manager from Dallas and one from Houston relocate to Austin. Ignore relocation expenses. Is their annual compensation relevant to the decision to expand?

11.4 MusicHeaven, Inc., is a producer of media players, which currently have either 20 gigabytes or 30 gigabytes of storage. Now the company is considering launching a new production line making mini media players with 5 gigabytes of storage. Analysts forecast that MusicHeaven will be able to sell 1 million such mini media players if the investment is made. In making the investment decision, discuss what the company should consider other than the sales of the mini media players.

11.5 QualityLiving Trust is a real estate investment company that builds and remodels apartment buildings in northern California. It is currently considering remodeling a few idle buildings that it owns in San Jose into luxury apartment buildings. The company bought those buildings eight months ago. How should the market value of the buildings be treated in evaluating this project?

11.6 High-End Fashions, Inc., bought a production line for ankle-length skirts last year at a cost of $500,000. This year, however, miniskirts are in and ankle-length skirts are completely out of fashion. High-End has the option to rebuild the production line and use it to produce miniskirts with an annual operating cost of $300,000 and expected revenue of $700,000. How should the company treat the $500,000 cost of the old production line in evaluating the rebuilding plan?

11.7 How is the MACRS depreciation method under IRS rules different from the straight-line depreciation allowed under GAAP rules? What is the implication on incremental after-tax free cash flows from firms' investments?

11.8 Explain the difference between marginal and average tax rates, and identify which of these rates is used in capital budgeting and why.

11.9 Under what circumstances will the sale of an asset result in a taxable gain? How do you estimate the taxes or tax benefit associated with the sale of an asset?

11.10 When two mutually exclusive projects have different lives, how can an analyst determine which is better? What is the underlying assumption in this method?

11.11 What is the opportunity cost of using an existing asset? Give an example of the opportunity cost of using the excess capacity of a machine.

11.12 You are providing financial advice to a shrimp farmer who will be harvesting his last crop of farm-raised shrimp. His current shrimp crop is very young and will, therefore, grow and become more valuable as their weight increases. Describe how you would determine the appropriate time to harvest the entire crop of shrimp.

Questions and Problems

Basic

11.1 Calculating project cash flows: Why do we use forecasted incremental after-tax free cash flows instead of forecasted accounting earnings in estimating the NPV of a project?

11.2 The FCF calculation: How do we calculate incremental after-tax free cash flows from forecasted earnings of a project? What are the common adjustment items?

11.3 The FCF calculation: How do we adjust for depreciation when we calculate incremental after-tax free cash flow from EBITDA? What is the intuition for the adjustment?

11.4 Nominal versus real cash flows: What is the difference between nominal and real cash flows? Which rate of return should we use to discount each type of cash flow?

11.5 Taxes and depreciation: What is the difference between average tax rate and marginal tax rate? Which one should we use in calculating incremental after-tax cash flows?

11.6 Computing terminal-year FCF: Healthy Potions, Inc., a pharmaceutical company, bought a machine at a cost of $2 million five years ago that produces pain-reliever medicine. The machine has been depreciated over the past five years, and the current book value is $800,000. The company decides to sell the machine now at its market price of $1 million. The marginal tax rate is 30 percent. What are the relevant cash flows? How do they change if the market price of the machine is $600,000 instead?

11.7 Cash flows from operations: What are variable costs and fixed costs? What are some examples of each? How are these costs estimated in forecasting operating expenses?

11.8 Cash flows from operations: When forecasting operating expenses, explain the difference between a fixed cost and a variable cost.

11.9 Investment cash flows: Zippy Corporation just purchased computing equipment for $20,000. The equipment will be depreciated using a five-year MACRS depreciation schedule. If the equipment is sold at the end of its fourth year for $12,000, what are the after-tax proceeds from the sale, assuming the marginal tax rate is 35 percent?

11.10 Investment cash flows: Six Twelve, Inc., is considering opening up a new convenience store in downtown New York City. The expected annual revenue at the new store is $800,000. To estimate the increase in working capital, analysts estimate the ratio of cash and cash equivalents to revenue to be 0.03 and the ratios of receivables, inventories, and payables to revenue to be 0.05, 0.10, and 0.04, respectively, in the same industry. What is the expected incremental cash flow related to working capital when the store is opened?

11.11 Investment cash flows: Keswick Supply Company wants to set up a division that provides copy and fax services to businesses. Customers will be given 20 days to pay for such services. The annual revenue of the division is estimated to be $25,000. Assuming that the customers take the full 20 days to pay, what is the incremental cash flow associated with accounts receivable?

11.12 Expected cash flows: Define *expected cash flows,* and explain why this concept is important in evaluating projects.

11.13 Projects with different lives: Explain the concept of equivalent annual cost and how it is used to compare projects with different lives.

11.14 Replace an existing asset: Explain how we determine the optimal time to replace an existing asset with a new one.

11.15 Projects with different lives: If you had to choose between one project with an expected life of five years and a second project with an expected life of six years, how could you do this without using the equivalent annual cost concept?

Intermediate

11.16 Nominal versus real cash flows: You are buying a sofa. You will pay $200 today and make three consecutive annual payments of $300 in the future. The real rate of return is 10 percent, and the expected inflation rate is 4 percent. What is the actual price of the sofa?

11.17 Nominal versus real cash flows: You are graduating in two years. You want to invest your current savings of $5,000 in bonds and use the proceeds to purchase a new car when you graduate and start to work. You can invest the money in either Bond A, a two-year bond with a 3 percent annual interest rate, or Bond B, an inflation-indexed two-year bond paying 1 percent real interest above the inflation rate (assume this bond makes annual interest payments). The inflation rate over the next two years is expected to be 1.5 percent. Assume that both bonds are default free and have the same market price. Which bond should you invest in?

11.18 Marginal and average tax rates: Given the U.S. Corporate Tax Rate Schedule in Exhibit 11.6, what was the marginal tax rate and average tax rate of a corporation that had a taxable income of $12 million in 2016?

11.19 Investment cash flows: Healthy Potions, Inc., is considering investing in a new production line for eye drops. Other than investing in the equipment, the company needs to increase its cash and cash equivalents by $10,000, increase the level of inventory by $30,000, increase accounts receivable by $25,000, and increase accounts payable by $5,000 at the beginning of the project. Healthy Potions will recover these changes in working capital at the end of the project 10 years later. Assume the appropriate discount rate is 12 percent. What are the present values of the relevant investment cash flows?

11.20 Cash flows from operations: Given the soaring price of gasoline, Ford is considering introducing a new production line of gas-electric hybrid sedans. The expected annual unit sales of the hybrid cars is 30,000; the price is $22,000 per car. Variable costs of

production are $10,000 per car. The fixed overhead including salary of top executives is $80 million per year. However, the introduction of the hybrid sedan will decrease Ford's sales of regular sedans by 10,000 cars per year; the regular sedans have a unit price of $20,000, a unit variable cost of $12,000, and fixed costs of $250,000 per year. Depreciation costs of the production plant are $50,000 per year. The marginal tax rate is 40 percent. What is the incremental annual cash flow from operations?

11.21 FCF and NPV for a project: Archer Daniels Midland Company is considering buying a new farm that it plans to operate for 10 years. The farm will require an initial investment of $12 million. This investment will consist of $2 million for land and $10 million for trucks and other equipment. The land, all trucks, and all other equipment are expected to be sold at the end of 10 years for a price of $5 million, which is $2 million above book value. The farm is expected to produce revenue of $2 million each year, and annual cash flow from operations equals $1.8 million. The marginal tax rate is 35 percent, and the appropriate discount rate is 10 percent. Calculate the NPV of this investment.

11.22 Projects with different lives: You are trying to choose between purchasing one of two machines for a factory. Machine A costs $15,000 to purchase and has a three-year life. Machine B costs $17,700 to purchase but has a four-year life. Regardless of which machine you purchase, it will have to be replaced at the end of its operating life. Which machine should you choose? Assume a marginal tax rate of 35 percent and a discount rate of 15 percent.

11.23 Projects with different lives: You are starting a family pizza parlor and need to buy a motorcycle for delivery orders. You have two models in mind. Model A costs $9,000 and is expected to run for 6 years; Model B is more expensive, with a price of $14,000, and has an expected life of 10 years. The annual maintenance costs are $800 for Model A and $700 for Model B. Assume that the opportunity cost of capital is 10 percent. Which one should you buy?

11.24 When to harvest an asset: Predator LLC, a leveraged-buyout specialist, recently bought a company and wants to determine the optimal time to sell it. The partner in charge of this investment has estimated the after-tax cash flows from a sale at different times to be as follows: $700,000 if sold one year later; $1,000,000 if sold two years later; $1,200,000 if sold three years later; and $1,300,000 if sold four years later. The opportunity cost of capital is 12 percent. When should Predator sell the company? Why?

11.25 Replace an existing asset: Bell Mountain Vineyards is considering updating its current manual accounting system with a high-end electronic system. While the new accounting system would save the company money, the cost of the system continues to decline. Bell Mountain's opportunity cost of capital is 10 percent, and the costs and values of investments made at different times in the future are as follows:

Year	Cost	Value of Future Savings (at time of purchase)
0	$5,000	$7,000
1	4,500	7,000
2	4,000	7,000
3	3,600	7,000
4	3,300	7,000
5	3,100	7,000

When should Bell Mountain buy the new accounting system?

11.26 Replace an existing asset: You have a 2000 Nissan that is expected to run for another three years, but you are considering buying a new Hyundai before the Nissan wears out. You will donate the Nissan to Goodwill when you buy the new car. The annual maintenance cost is $1,500 per year for the Nissan and $200 for the Hyundai. The price of your favorite Hyundai model is $18,000, and it is expected to run for 15 years. Your opportunity cost of capital is 3 percent. Ignore taxes. When should you buy the new Hyundai?

11.27 Replace an existing asset: Assume that you are considering replacing your old Nissan with a new Hyundai, as in the previous problem. However, the annual maintenance cost of the old Nissan increases as time goes by. It is $1,200 in the first year, $1,500 in the second year, and $1,800 in the third year. When should you replace the Nissan with the new Hyundai in this case?

11.28 When to harvest an existing asset: Anaconda Manufacturing Company currently owns a mine that is known to contain a certain amount of gold. Since Anaconda does not have any gold-mining expertise, the company plans to sell the entire mine and base the selling price on a fixed multiple of the spot price for gold at the time of the sale. Analysts at Anaconda have forecast the spot price for gold and have determined that the price will increase by 14 percent, 12 percent, 9 percent, and 6 percent during the next one, two, three, and four years, respectively. If Anaconda's opportunity cost of capital is 10 percent, what is the optimal time for Anaconda to sell the mine?

11.29 Replace an existing asset: You are thinking about delivering pizzas in your spare time. Since you must use your own car to deliver the pizzas, you will wear out your current car one year earlier, which is one year from today, than if you did not take on the delivery job. You estimate that when you purchase a new car, regardless of when that occurs, you will pay $20,000 for the car and it will last you five years. If your opportunity cost of capital is 7 percent, what is the opportunity cost of using your car to deliver pizzas?

Advanced

11.30 You are the CFO of SlimBody, Inc., a retailer of the exercise machine Slimbody6 and related accessories. Your firm is considering opening a new store in Los Angeles. The store will have a life of 20 years. It will generate annual sales of 5,000 exercise machines, and the price of each machine is $2,500. The annual sales of accessories will be $600,000, and the operating expenses of running the store, including labor and rent, will amount to 50 percent of the revenues from the exercise machines. The initial investment in the store will equal $30 million and will be fully depreciated on a straight-line basis over the 20-year life of the store. Your firm will need to invest $2 million in additional working capital immediately and recover it at the end of the investment. Your firm's marginal tax rate is 30 percent. The opportunity cost of opening up the store is 10 percent. What are the incremental free cash flows from this project at the beginning of the project as well as in Years 1–19 and 20? Should you approve it?

11.31 Merton Shovel Corporation has decided to bid for a contract to supply shovels to the Honduran Army. The Honduran Army intends to buy 1,000 shovels per year for the next three years. To supply these shovels, Merton will have to acquire manufacturing equipment at a cost of $150,000. This equipment will be depreciated on a straight-line basis over its five-year lifetime. At the end of the third year, Merton can sell the equipment for exactly its book value ($60,000). Additional fixed costs will be $36,000 per year, and variable costs will be $3.00 per shovel. An additional investment of $25,000 in net working capital will be required when the project is initiated. This investment will be recovered at the end of the third year. Merton Shovel has a 35 percent marginal tax rate and a 17 percent required rate of return on the project. What is the lowest possible per shovel price that Merton can offer for the contract and still create value for its stockholders?

11.32 Rocky Mountain Lumber, Inc., is considering purchasing a new wood saw that costs $50,000. The saw will generate revenues of $100,000 per year for five years. The cost of materials and labor needed to generate these revenues will total $60,000 per year, and other cash expenses will be $10,000 per year. The machine is expected to sell for $1,000 at the end of its five-year life and will be depreci-ated on a straight-line basis over five years to zero. Rocky Mountain's tax rate is 34 percent, and its opportunity cost of capital is 10 percent. Should the company purchase the saw? Explain why or why not.

11.33 A beauty product company is developing a new fragrance named Happy Forever. There is a probability of 0.5 that consumers will love Happy Forever, and in this case, annual sales will be 1 million bottles; a probability of 0.4 that consumers will find the smell acceptable and annual sales will be 200,000 bottles; and a probability of 0.1 that consumers will fi nd the smell unpleasant and annual sales will be only 50,000 bottles. The selling price is $38, and the variable cost is $8 per bottle. Fixed production costs will be $1 million per year, and depreciation will be $1.2 million. Assume that the marginal tax rate is 40 percent. What are the expected annual incremental after-tax free cash flows from the new fragrance?

11.34 Great Fit, Inc., is a company that manufactures clothing. The company has a production line that produces women's tops of regular sizes. The same machine could be used to produce petite sizes as well. However, the remaining life of the machines will be reduced from four years to two years if the petite size production is added. The cost of identical machines with a life of eight years is $2 million. Assume the opportunity cost of capital is 8 percent. What is the opportunity cost of adding petite sizes?

11.35 Biotech Partners LLC has been farming a new strain of radioactive-material-eating bacteria that the electrical utility industry can use to help dispose of its nuclear waste. Two opposing factors affect Biotech's decision of when to harvest the bacteria. The bacteria are currently growing at a 22 percent annual rate, but due to known competition from other top firms, Biotech analysts estimate that the price for the bacteria will decline according to the schedule below. If the opportunity cost of capital is 10 percent, then when should Biotech harvest the entire bacteria colony at one time?

Year	Change in Price Due to Competition (%)
1	5%
2	−2
3	−8
4	−10
5	−15
6	−25

11.36 ACME Manufacturing management is considering replacing an existing production line with a new line that has a greater output capacity and operates with less labor than the existing line. The new line would cost $1 million, have a five-year life, and be depreciated using MACRS over three years. At the end of five years, the new line could be sold as scrap for $200,000 (in Year 5 dollars). Because the new line is more automated, it would require fewer operators, resulting in a savings of $40,000 per year before tax and unadjusted for inflation (in today's dollars). Additional sales with the new machine are expected to result in additional net cash inflows, before tax, of $60,000 per year (in today's dollars). If ACME invests in the new line, a one-time investment of $10,000 in additional working capital will be required. The tax rate is 35 percent, the opportunity cost of capital is 10 percent, and the annual rate of inflation is 3 percent. What is the NPV of the new production line?

11.37 The alternative to investing in the new production line in Problem 11.36 is to overhaul the existing line, which currently has both a book value and a salvage value of $0. It would cost $300,000 to overhaul the existing line, but this expenditure would extend its useful life to five years. The line would have a $0 salvage value at the end of five years. The overhaul outlay would be capitalized and depreciated using MACRS over three years. Should ACME replace or renovate the existing line?

CFA Problems

11.38 FITCO is considering the purchase of new equipment. The equipment costs $350,000, and an additional $110,000 is needed to install it. The equipment will be depreciated straight-line to zero over a five-year life. The equipment will generate additional annual revenues of $265,000, and it will have annual cash operating expenses of $83,000. The equipment will be sold for $85,000 after five years. An inventory investment of $73,000 is required during the life of the investment. FITCO is in the 40 percent tax bracket, and its cost of capital is 10 percent. What is the project NPV?

a. $47,818.

b. $63,658.

c. $80,189.

d. $97,449.

11.39 After estimating a project's NPV, the analyst is advised that the fixed capital outlay will be revised upward by $100,000. The fixed capital outlay is depreciated straight-line over an eight-year life. The tax rate is 40 percent, and the required rate of return is 10 percent. No changes in cash operating revenues, cash operating expenses, or salvage value are expected. What is the effect on the project NPV?

a. $100,000 decrease.

b. $73,325 decrease.

c. $59,988 decrease.

d. No change.

11.40 When assembling the cash flows to calculate an NPV or IRR, the project's after-tax interest expenses should be subtracted from the cash flows for:

a. The NPV calculation, but not the IRR calculation.

b. The IRR calculation, but not the NPV calculation.

c. Both the NPV calculation and the IRR calculation.

d. Neither the NPV calculation nor the IRR calculation.

Sample Test Problems

11.1 You purchased 100 shares of stock in an oil company, Texas Energy, Inc., at $50 per share. The company has 1 million shares outstanding. Ten days later, Texas Energy announced an investment in an oil field in east Texas. The probability that the investment will be successful and generate an NPV of $10 million is 0.2; the probability that the investment will be a failure and generate an NPV of negative $1 million is 0.8. How would you expect the stock price to change upon the company's announcement of the investment?

11.2 A division of Virginia City Highlands Manufacturing is considering purchasing for $1,500,000 a machine that automates the process of inserting electronic components onto computer motherboards. The annual cost of operating the machine will be $50,000, but it will save the company $370,000 in labor costs each year. The machine will have a useful life of 10 years, and its salvage value in 10 years is estimated to be $300,000. Straight-line depreciation will be used in calculating taxes for this project, and the marginal corporate tax rate is 32 percent. If the appropriate discount rate is 12 percent, what is the NPV of this project?

11.3 After examining the NPV analysis for a potential project that would increase the firm's output by 5 percent, an analyst's manager tells the analyst to increase the initial fixed capital outlay in the analysis by $480,000. The initial fixed capital outlay would be fully depreciated on a straight-line basis over a 12-year life, regardless of whether it is increased. If the firm's average tax rate is 28 percent, its marginal tax rate is 35 percent, and the required rate of return is 10 percent, what is the effect of the adjustment on the project NPV?

11.4 Which of the following are relevant cash flows in the evaluation of a proposal to produce a new product?

a. Decrease in the cash flows of a substitute product.

b. Alternative of leasing an existing building that will be used for manufacturing this product.

c. The cost of a new machine required to produce this product.

d. Salvage value of the new machine at the end of its useful life.

e. Increase in net working capital at the beginning of the project's life.

f. Cost to develop a product prototype last year.

11.5 Managers of Central Embroidery have decided to purchase a new monogram machine and are considering two alternative machines. The first machine costs $100,000 and is expected to last five years. The second machine costs $160,000 and is expected to last eight years. Assume that the opportunity cost of capital is 8 percent. Which machine should Central Embroidery purchase?

11.6 You have inherited an apple orchard and want to sell it in the next four years. An expert in apple orchard valuation has estimated the after-tax cash flow you would receive if you sold at the end of each of the next four years as follows: $1,000,000 if you sell in one year; $1,300,000 if you sell in two years; $1,500,000 if you sell in three years; and $1,600,000 if you sell in four years. Your opportunity cost of capital is 10 percent. When should you sell the orchard?

$$\text{Op Ex} = \text{VC} + \text{FC} \tag{12.1}$$

EXHIBIT 12.1 **Unit and Annual Costs for Hammock Project**

To evaluate the automated and manual production alternatives in our hammock-manufacturing example, we start with information about the variable costs per unit (Unit VC), fixed costs (FC), and depreciation and amortization (D&A).

	Automated Production	Manual Production
Unit VC:		
Labor	$1	$5
Rope	5	5
Spacer bars	2	2
Hardware	2	2
Packaging	2	2
Shipping and other	4	4
Total	$16	$20
FC	$35,000	$4,000
D&A	$10,000	$1,000

EXHIBIT 12.2 **EBITDA under Alternative Production Technologies**

Here we calculate EBITDA for the automated and manual production alternatives in the hammock-manufacturing example. The calculations use the information provided in Exhibit 12.1 and assume that 10,000 units are sold at a price of $25 per unit.

	Automated Production	Manual Production
Units sold	10,000	10,000
Unit price	$25	$25
Unit VC	$16	$20
Revenue	$250,000	$250,000
– VC	160,000	200,000
– FC	35,000	4,000
= EBITDA	$ 55,000	$ 46,000

EXHIBIT 12.3 **Changes in EBITDA under Alternative Production Technologies**

EBITDA for the automated and manual production alternatives in the hammock-manufacturing example declines by different amounts when the number of units sold declines 20 percent and the unit price remains the same.

	Automated Production		Manual Production	
	Expected Demand (1)	Poor Demand (2)	Expected Demand (3)	Poor Demand (4)
Units sold	10,000	8,000	10,000	8,000
Unit price	$25	$25	$25	$25
Unit VC	$16	$16	$20	$20
Revenue	$250,000	$200,000	$250,000	$200,000
– VC	160,000	128,000	200,000	160,000
– FC	35,000	35,000	4,000	4,000
= EBITDA	$ 55,000	$ 37,000	$ 46,000	$ 36,000
Percent change in revenue[a]		–20.0%		–20.0%
Percent change in EBITDA		–32.7%		–21.7%

[a]The percent change in revenue is calculated as:

$$\text{Percent change} = (\text{Revenue}_{\text{Poor}} - \text{Revenue}_{\text{Expected}})/\text{Revenue}_{\text{Expected}}$$
$$= (\$200{,}000 - \$250{,}000)/\$250{,}000 = -0.20, \text{ or } -20\%$$

All other percent changes are calculated this way in the exhibits.

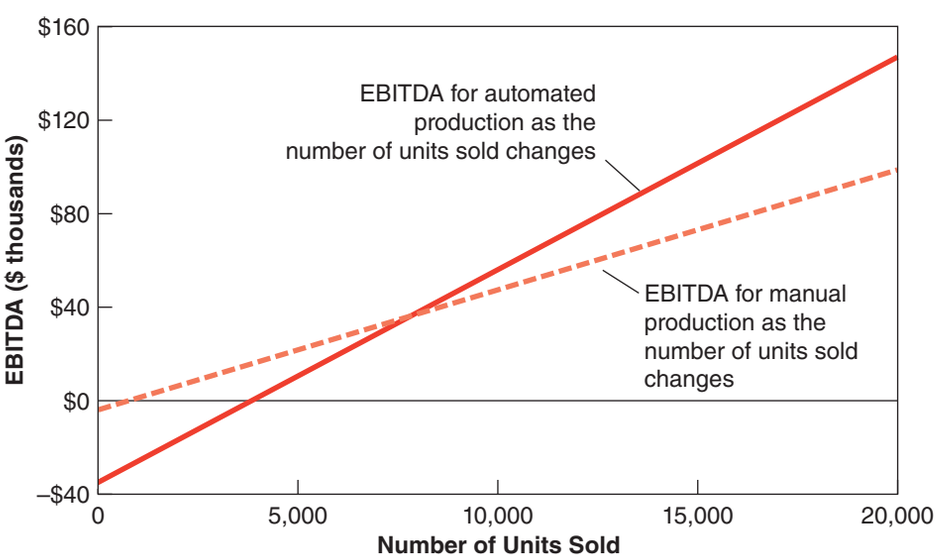


EXHIBIT 12.4 **EBITDA for Different Levels of Unit Sales**

The sensitivity of EBITDA to changes in unit sales differs for the automated and manual production alternatives in the hammock-manufacturing example. The steeper line for the automated production alternative means that EBITDA for this alternative is more sensitive to changes in the number of units sold.

EXHIBIT 12.5 **Changes in EBITDA and EBIT under Alternative Production Technologies**

The EBIT values for the automated and manual production alternatives in the hammock-manufacturing example decline more than the EBITDA values when the number of units sold declines 20 percent and the unit price remains the same. This occurs because the fixed nature of depreciation and amortization (D&A) charges has the same effect as other fixed costs. When D&A is greater than zero, the percentage change in EBIT is greater than the percentage change in EBITDA.

	Automated Production		Manual Production	
	Expected Demand (1)	Poor Demand (2)	Expected Demand (3)	Poor Demand (4)
Units sold	10,000	8,000	10,000	8,000
Unit price	$25	$25	$25	$25
Unit VC	$16	$16	$20	$20
Revenue	$250,000	$200,000	$250,000	$200,000
− VC	160,000	128,000	200,000	160,000
− FC	35,000	35,000	4,000	4,000
= EBITDA	$ 55,000	$ 37,000	$ 46,000	$ 36,000
− D&A	10,000	10,000	1,000	1,000
= EBIT	$ 45,000	$ 27,000	$ 45,000	$ 35,000
Percent change in revenue		−20.0%		−20.0%
Percent change in EBITDA		−32.7%		−21.7%
Percent change in EBIT		−40.0%		−22.2%

LEARNING BY DOING

APPLICATION 12.1 | Forecasting EBIT

Problem You have decided to start a business that provides in-home technical computer support to people in the community near your university. You have seen national advertisements for a company that provides these services in other communities. You would run this business out of your dorm room, and you know plenty of students who have the necessary technical skills and would welcome the opportunity to earn more than the university pays under its work-study programs. To get up and running quickly, you would have to invest in a computer system, an advertising campaign, three vehicles, and tools. You would also want to have enough cash to keep the business going until it began to generate positive cash flows. All of this would require about $100,000, which is about all that you think you can borrow on your credit cards, against your car, and from friends and family.

You are now working on the financial forecasts for the business. You plan to charge $45 for house calls lasting up to 30 minutes and $25 for each additional 30 minutes. Since you expect that the typical house call will require 60 minutes, you expect it to result in revenue of $70. You also estimate that monthly fixed operating costs (FC), which include an advertising contract with a local radio station and a small salary for you, will total $3,000. Unit VC, including the technicians' pay, gas, and so forth, will total $20 for the typical house call. Monthly depreciation and amortization charges (D&A) will be $1,000. Finally, you expect that after six months the business will average 120 house calls per month. Given this information, what do you expect the monthly EBIT to be in six months?

Approach Since EBIT = Revenue − VC − FC − D&A (see, for example, the calculation in Exhibit 12.5), you can forecast the expected monthly EBIT in six months by using this equation and the values for Revenue, VC, FC, and D&A that you expect in six months.

Solution The calculation is as follows:

Revenue	$70 per house call × 120 house calls =	$8,400
− VC	$20 per house call × 120 house calls =	2,400
− FC		3,000
− D&A		1,000
= EBIT		$2,000

APPLICATION 12.2 | Fixed Costs and Fluctuations in EBIT

LEARNING BY DOING

Problem As you prepare the financial forecast for your computer-support business, you worry about the impact of fluctuations in the number of house calls on EBIT. You decide to examine how converting some fixed costs to variable costs will affect the sensitivity of EBIT to changes in the number of house calls. In a conversation with the manager at the radio station where you would be advertising, you discover that instead of paying $1,500 per month under a long-term advertising contract, you can get the same level of advertising for $1,600, where $1,000 of the total cost is fixed and $600 is variable. That is, in a given month, if you used the full level of advertising, you would pay $1,600, but you would also have the ability to reduce advertising costs to $1,000 by cutting back on the number of advertisements. You wonder how this contract would affect the sensitivity of EBIT to a decrease in the monthly number of house calls—say, from 120 to 90.

Approach To determine how the sensitivity of EBIT differs between the $1,500 per month long-term contract and the contract that has only $1,000 of fixed costs, you must calculate EBIT under each alternative contact for 120 house calls and for 90 house calls. Using these EBIT values, you must next calculate the percentage decrease in EBIT if the number of monthly house calls declines from 120 to 90 for each alternative. You can then compare the percentage decreases to see the difference in the sensitivity of EBIT to the decrease in the number of house calls.

Solution *$1,500 monthly fixed contract:* As we determined in Learning by Doing Application 12.1, EBIT is $2,000 with 120 house calls per month. With 90 house calls per month instead of 120, revenue would be $6,300 per month ($70 per house call × 90 house calls = $6,300) instead of $8,400 ($70 per house call × 120 house calls = $8,400) and EBIT would decline to $500:

$$\begin{aligned}\text{EBIT} &= \text{Revenue} - \text{VC} - \text{FC} - \text{D\&A}\\ &= \$6{,}300 - (\$20 \times 90) - \$3{,}000 - \$1{,}000\\ &= \$500\end{aligned}$$

This represents a 75 percent decrease in EBIT ([$500 − $2,000]/$2,000 = −0.75, or −75 percent).

$1,600 monthly contract with $1,000 fixed: Switching to the alternative advertising arrangement would increase unit variable costs by $5 ($600/120 house calls = $5 per house call) but would decrease fixed costs by $500 ($3,000 − $2,500 = $500). EBIT with 120 house calls per month would equal $1,900:

$$\begin{aligned}\text{EBIT} &= \text{Revenue} - \text{VC} - \text{FC} - \text{D\&A}\\ &= \$8{,}400 - (\$25 \times 120) - \$2{,}500 - \$1{,}000\\ &= \$1{,}900\end{aligned}$$

With 90 house calls, EBIT would decline to $550:

$$\text{EBIT} = \$6{,}300 - (\$25 \times 90) - \$2{,}500 - \$1{,}000 = \$550$$

This represents a 71 percent decrease in EBIT [($550 − $1,900)/$1,900 = −0.71, or −71 percent].

If the business averaged 120 house calls per month, EBIT under the alternative advertising arrangement would be $100 lower than EBIT under the original advertising arrangement. However, it would actually be $50 higher if the business averaged only 90 house calls per month because you would be able to cut back on advertising expenses under the alternative agreement if demand were poor.

Using Excel

Examining the Impact of Changes in Your Assumptions

One of the main advantages of using a spreadsheet program for financial analysis is that it enables us to perform a sensitivity analysis in a matter of seconds. Once the spreadsheet is carefully set up with all the relevant key assumptions and calculations, we can change any one of the assumptions and immediately see the effect on the bottom line.

Below is a setup for Learning by Doing Applications 12.1 and 12.2 that analyzes the impact of the alternative advertising schemes on the EBIT of the in-home technical computer-support business.

Notice that the actual EBIT calculation is entirely derived from formulas utilizing inputs from the key assumptions. To use the model for sensitivity analysis, all you have to do is change the values for the volume of calls per month for the two advertising alternatives (in cell B11 and D11). For example, when you change the volume number for the alternative advertising scenario back to 120, EBIT equals $1,900, just as it does in Learning by Doing Application 12.2.

<>	A	B	C	D	E	F	G	H	I	J
1										
2	**Key Assumptions:**	**Fixed Advertising Contract with More House Calls**		**Alternative Advertising Contract with Fewer House Calls**						
3	House call up to 30 minutes	$45		$45						
4	Each additional 30 minutes	$25		$25						
5	Revenue from typical call - unit (60 min.)	$70		$70						
6	FC	$3,000		$2,500						
7	VC/unit (technician's pay, gas, etc.)	$20		$20						
8	Alternative advertising option VC			$600						
9	VC/unit of alternative advertising option			$5	*=D8/B11*					
10	Monthly D&A	$1,000		$1,000						
11	Volume of calls per month	120		90						
12										
13										
14	**Fixed Advertising Contract:**						**Alternative Advertising Contract:**			
15	Revenue	$8,400		*=B11*B5*			Revenue	$6,300	*=D11*D5*	
16	Less: Variable cost (VC)	$2,400		*=B11*B7*			Less: Variable cost (VC)	$2,250	*=D11*(D7+D9)*	
17	Less: Fixed cost (FC)	$3,000		*=B6*			Less: Fixed cost (FC)	$2,500	*=D6*	
18	Less: Depreciation and Amortization	$1,000		*=B10*			Less: Depreciation and Amortization	$1,000	*=D10*	
19	**EBIT**	**$2,000**		*=B15-B16-B17-B18*			**EBIT**	**$550**	*=H15-H16-H17-H18*	
20										
21										

$$\text{Cash Flow DOL} = 1 + \frac{\text{Fixed costs}}{\text{Pretax operating cash flows}} = 1 + \frac{\text{FC}}{\text{EBITDA}} \qquad (12.2)$$

Figure 12.1

$$\text{Cash Flow DOL}_{\text{Automated}} = 1 + \frac{\text{FC}}{\text{EBITDA}} = 1 + \frac{\$35{,}000}{\$55{,}000} = 1.64$$

EXHIBIT 12.6 **EBITDA with Unit Sales of 10,000 and 20,000 for the Automated Production Alternative**

For the automated production alternative in the hammock-manufacturing example, EBITDA increases from $55,000 to $145,000 when unit sales increase from 10,000 to 20,000 units.

Units sold	10,000	20,000
Unit price	$25	$25
Unit VC	$16	$16
Revenue	$250,000	$500,000
− VC	160,000	320,000
− FC	35,000	35,000
= EBITDA	$ 55,000	$145,000

$$\text{Accounting DOL} = 1 + \frac{\text{Fixed charges}}{\text{Accounting operating profits}} \qquad (12.3)$$

$$= 1 + \frac{\text{FC} + \text{D\&A}}{\text{EBITDA} - \text{D\&A}}$$

$$= 1 + \frac{\text{FC} + \text{D\&A}}{\text{EBIT}}$$

Figure 12.2

$$\text{Accounting DOL}_{\text{Automated}} = 1 + \frac{\text{FC} + \text{D\&A}}{\text{EBIT}}$$

$$= 1 + \frac{\$35{,}000 + \$10{,}000}{\$45{,}000}$$

$$= 2.00$$

APPLICATION 12.3 | Calculating Cash Flow and Accounting DOL

LEARNING BY DOING

Problem You have decided to calculate the operating leverage for the in-home computer-support business you are thinking about starting. What will Cash Flow DOL and Accounting DOL be in six months if EBIT is $2,000, FC is $3,000, and D&A is $1,000?

Approach Use Equations 12.2 and 12.3 to calculate Cash Flow DOL and Accounting DOL, respectively.

Solution From Equation 12.2, Cash Flow DOL is:

$$\text{Cash Flow DOL} = 1 + \frac{\text{FC}}{\text{EBIT} + \text{D\&A}} = 1 + \frac{\$3{,}000}{\$2{,}000 + \$1{,}000} = 2.00$$

From Equation 12.3, Accounting DOL is:

$$\text{Accounting DOL} = 1 + \frac{\text{FC} + \text{D\&A}}{\text{EBIT}} = 1 + \frac{\$3{,}000 + \$1{,}000}{\$2{,}000} = 3.00$$

Pretax Operating Cash Flow Break-Even

When evaluating a project, we might want to know what level of unit sales is necessary for the project to break even on operations from a pretax operating cash flow perspective. In other words, how many units must be sold for pretax operating cash flow to equal \$0? This is a very important question; if the project fails to break even from a pretax operating cash flow perspective, the firm will have to put more cash into the project to keep it going. The **pretax operating cash flow (EBITDA) break-even point** is calculated as follows:

$$\text{EBITDA Break-even} = \frac{\text{FC}}{\text{Price} - \text{Unit VC}} \tag{12.4}$$

For our hammock-manufacturing example, we can calculate the EBITDA break-even points for the automated and manual production alternatives as follows:

$$\text{EBITDA Break-even}_{\text{Automated}} = \frac{\$35{,}000}{\$25 - \$16} = 3{,}889 \text{ units}$$

$$\text{EBITDA Break-even}_{\text{Manual}} = \frac{\$4{,}000}{\$25 - \$20} = 800 \text{ units}$$

In each of these calculations, we are simply dividing the fixed costs, FC, by the **per-unit contribution** (Price − Unit VC). The per-unit contribution is how much money is left from the sale of a single unit after all the variable costs associated with that unit have been paid. This is the amount that is available to help cover FC for the project.

In the hammock-manufacturing example, we see that if the automated production alternative is selected instead of the manual production alternative, almost five times as many units (3,889 versus 800 units) will have to be sold before the project breaks even on a pretax operating cash flow basis in a particular year. This is because the automated production alternative has much higher fixed costs (\$35,000 versus \$4,000) than the manual production alternative, but its per-unit contribution is not proportionately higher (only \$9 versus \$5).

Learning by Doing Application 12.4 illustrates another EBITDA Break-even point calculation.

Because the pretax operating cash flow break-even points are the unit sales levels at which EBITDA equals \$0, they are the unit sales levels at which the lines in Exhibit 12.4 cross the \$0 point. You can see this in **Exhibit 12.7**, which is the same as Exhibit 12.4, except that, for simplicity, it plots EBITDA only from 0 to 10,000 units.

LEARNING BY DOING

APPLICATION 12.4 | Calculating the EBITDA Break-Even Point

Problem Calculate the expected pretax operating cash flow (EBITDA) break-even number of house calls per month for the in-home computer-support business after six months.

Approach Use Equation 12.4 to calculate the EBITDA break-even point.

Solution From Learning by Doing Application 12.1, we know that the monthly fixed costs (FC) are \$3,000, the average revenue per house call (Price) is \$70, and the variable cost per house call (Unit VC) is \$20. Therefore, using Equation 12.4, we can calculate the EBITDA break-even point as follows:

$$\text{EBITDA Break-even} = \frac{\text{FC}}{\text{Price} - \text{Unit VC}} = \frac{\$3{,}000}{\$70 - \$20} = 60 \text{ house calls per month}$$

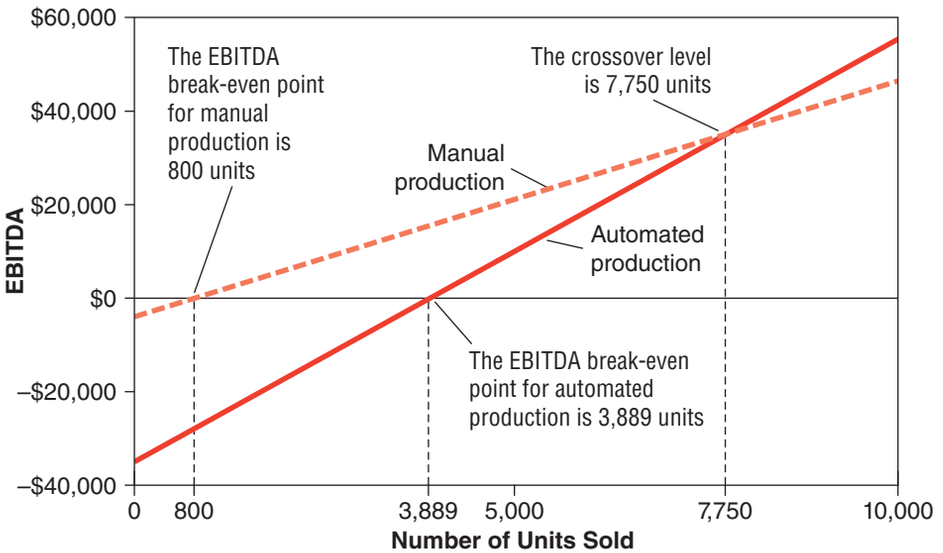


EXHIBIT 12.7 **EBITDA Break-Even Points and Crossover Level of Unit Sales**

The EBITDA break-even points for the automated and manual production alternatives in the hammock-manufacturing example tell us the unit sales at which pretax operating cash flows equals $0. The crossover level of unit sales for EBITDA (CO_{EBITDA}) tells us the number of units at which the pretax operating cash flows become higher for the automated process than for the manual process.

In addition to illustrating the operating cash flow break-even points, Exhibit 12.7 shows that the automated production alternative has a larger EBITDA than the manual production alternative if sales exceed 7,750 units. This is because the larger per-unit contribution of the automated production alternative more than makes up for the higher fixed charges at this level of unit sales. We can compute the EBITDA **crossover level of unit sales (CO)**—the level above which the automated production alternative has higher pretax operating cash flows—as follows:

$$CO_{EBITDA} = \frac{FC_{Alternative\ 1} - FC_{Alternative\ 2}}{\text{Unit contribution}_{Alternative\ 1} - \text{Unit contribution}_{Alternative\ 2}} \tag{12.5}$$

where Unit contribution stands for the per-unit contribution. The calculation for our example is as follows:

$$\begin{aligned} CO_{EBITDA} &= \frac{FC_{Automated} - FC_{Manual}}{\text{Unit contribution}_{Automated} - \text{Unit contribution}_{Manual}} \\ &= \frac{\$35{,}000 - \$4{,}000}{\$9 - \$5} \\ &= 7{,}750 \text{ units} \end{aligned}$$

Equation 12.5 can be used to calculate the crossover level of unit sales for any two alternatives that differ in the amount of operating leverage they employ.

$$\text{EBIT Break-even} = \frac{\text{FC} + \text{D\&A}}{\text{Price} - \text{Unit VC}} \tag{12.6}$$

Figure 12.3

$$\begin{aligned}\text{EBIT Break-even}_{\text{Automated}} &= \frac{\text{FC}_{\text{Automated}} + \text{D\&A}_{\text{Automated}}}{\text{Price} - \text{Unit VC}_{\text{Automated}}} \\ &= \frac{\$35{,}000 + \$10{,}000}{\$25 - \$16} \\ &= 5{,}000 \text{ units}\end{aligned}$$

Figure 12.4

$$\text{EBIT Break-even}_{\text{Manual}} = \frac{\$4{,}000 + \$1{,}000}{\$25 - \$20} = 1{,}000 \text{ units}$$

LEARNING BY DOING

APPLICATION 12.5 | Calculating the EBIT Break-Even Point

Problem Calculate the expected accounting operating profit break-even number of house calls per month for the in-home computer-support business after six months of operation.

Approach Use Equation 12.6 to calculate the EBIT break-even point for the business.

Solution From Learning by Doing Application 12.1, we know that the monthly fixed cost (FC) is $3,000, the monthly D&A is $1,000, the average revenue per house call (Price) is $70, and the variable cost per house call (Unit VC) is $20. Therefore, using Equation 12.6, we find that the accounting operating profit break-even point after six months is:

$$\text{EBIT Break-even} = \frac{\text{FC} + \text{D\&A}}{\text{Price} - \text{Unit VC}} = \frac{\$3{,}000 + \$1{,}000}{\$70 - \$20} = 80 \text{ house calls per month}$$

Your company must make 80 house calls per month to break even on an accounting operating profit basis.

By comparing this calculation and the calculation in Learning by Doing Application 12.4, you can see that the accounting operating profit break-even point (80 house calls) is higher than the pretax operating cash flow break-even point (60 house calls). As we explained in the text, this is because D&A is included in the accounting operating profit break-even calculation.

DECISION MAKING

EXAMPLE 12.1 | Using Break-Even Numbers

Situation You have just finished calculating the pretax operating cash flow and accounting operating profit break-even numbers for the in-home computer-support business. These numbers are as follows:

- Pretax operating cash flow break-even point: 720 house calls per year (60 per month)
- Accounting operating profit break-even point: 960 house calls per year (80 per month)

You have also just heard that the national company that provides these services is going to move to the town in which you are located. This has caused you to reduce your estimate of the annual number of house calls you can expect for your business in half, from 1,440 (120 per month) to 720. How will this affect your decision to enter this business?

Decision With annual unit sales of 720, EBIT will be negative and EBITDA will equal $0. With EBITDA of $0, the business will not generate any cash flows that can be used to make necessary investments, let alone enable you to earn the opportunity cost of capital on the money you invest in this business. You can see this by referring back to the FCF calculation in Equation 11.2 or Exhibit 11.1. This is a case where you do not even need to calculate the NPV to know that it is negative.

$$CO_{EBIT} = \frac{(FC + D\&A)_{Alternative\ 1} - (FC + D\&A)_{Alternative\ 2}}{\text{Unit contribution}_{Alternative\ 1} - \text{Unit contribution}_{Alternative\ 2}} \quad (12.7)$$

Figure 12.5

$$\begin{aligned} CO_{EBIT} &= \frac{(FC + D\&A)_{Automated} - (FC + D\&A)_{Manual}}{\text{Unit contribution}_{Automated} - \text{Unit contribution}_{Manual}} \\ &= \frac{(\$35{,}000 + \$10{,}000) - (\$4{,}000 + \$1{,}000)}{\$9 - \$5} \\ &= 10{,}000 \text{ units} \end{aligned}$$

12.4 The Economic Break-Even Point

LEARNING OBJECTIVE

4. Define the economic break-even point and be able to calculate it for a project.

Knowing the pretax operating cash flow and accounting operating profit break-even points on a year-by-year basis over the life of a project can help a financial manager ensure that sufficient cash is allocated to fund a project and to understand the impact of a project on the firm's accounting operating profits. The **economic break-even point** is a more comprehensive break-even measure that can help a financial manager assess the overall economic viability of a project. This measure tells the manager how low unit sales can get before a project destroys stockholder value. It is the number of units that must be sold each year over the life of a project in order for the NPV of that project to equal $0.

economic break-even point the number of units that must be sold each year during the life of a project so that the NPV of the project equals $0

The economic break-even point is a more comprehensive measure in a couple of ways. First, it considers the entire life of the project, rather than a single year. Second, it focuses on the after-tax free cash flows associated with the project rather than only on the cash flows or profits from operations. Unlike the other measures, the economic break-even point accounts for both the taxes and investments associated with a project.

We calculate the economic break-even point for a project using the following four step procedure:

1. Identify the present value of the net nonrecurring investments in real assets and working capital that are required for the project (this is the present value of the initial investment plus the after-tax cash flow associated with the salvage value and the recovery of working capital at the end of the project), the life of the project, and the opportunity cost of capital for the project. Use the above information in the present value of an ordinary annuity formula (Equation 6.1) to calculate the annual incremental after-tax free cash flow (FCF), that would make the project NPV equal \$0.
2. Use the FCF formula (Equation 11.2) to solve for the EBIT that corresponds to the FCF value calculated in Step 1. Note that this calculation requires estimates of annual depreciation and amortization (D&A), capital expenditures (Cap Exp), and additions to working capital (Add WC), as well as the firm's marginal tax rate (t).
3. Add the EBIT calculated in Step 2 to the annual D&A and fixed costs (FC). This calculation gives you the annual total contribution of the project (Revenue − VC) that is associated with an NPV of \$0.
4. Divide the annual total contribution by the unit contribution to obtain the number of units that would have to be sold annually for the project to have an NPV of \$0.

To see how this four-step procedure works, let's use it to calculate the economic break-even point for the automated production alternative for the hammock-manufacturing business.

In addition to the information previously given about the automated production alternative, we will assume that the project has a four-year life, that the initial investment is \$40,000, that the salvage value is expected to equal \$0, that the annual capital expenditures will equal \$0, that annual additions to working capital will equal \$2,000, that the firm's marginal tax rate is 35 percent, and that the opportunity cost of capital for the project is 10 percent.

1. From the above assumptions, we know that the initial investment is \$40,000, no salvage value is expected, and that additions to working capital will equal \$2,000 per year. If we assume that all \$8,000 of the working capital (\$2,000 per year × 4 years = \$8,000) will be recovered at the end of the project, the present value of the net nonrecurring investments is:

$$\begin{aligned}\text{PV(Net nonrecurring investments)} &= \$40{,}000 + \$8{,}000/(1.1)^4 \\ &= \$45{,}464\end{aligned}$$

In the capital budgeting calculations we discussed in Chapters 10 and 11, the NPV of a project will equal \$0 when the present value of the annual FCFs from the project, PV(FCF), equals the present value of the net nonrecurring investments. If we assume, for simplicity, that the FCF will be the same each year over the four-year life of the project, we can compute the annual FCF (FCF_t) at which the project will have an NPV of \$0 using the present value of an ordinary annuity formula. With a 10 percent discount rate, this calculation is (Note that this is equivalent to using the equivalent annual cost formula, Equation 11.5.):

$$\text{PV(FCF)} = \frac{\text{FCF}_t}{k}\left[1 - \frac{1}{(1+k)^n}\right]$$

$$\$45{,}464 = \frac{\text{FCF}_t}{0.10}\left[1 - \frac{1}{(1+0.10)^4}\right]$$

$$\text{FCF}_t = \frac{\$45{,}464 \times 0.10}{\left[1 - \frac{1}{(1+0.10)^4}\right]} = \$14{,}343$$

2. Knowing that $FCF_t = \$14{,}343$, Cap $Exp_t = \$0$, Add $WC_t = \$2{,}000$, $D\&A_t = \$10{,}000$ (from Exhibit 12.1), and $t = 35$ percent, we can use Equation 11.2 to calculate $EBIT_t$ for the manufacturing alternative. Since:

$$\begin{aligned} FCF_t &= [(Revenue_t - Op\ Ex_t - D\&A_t) \times (1 - t)] + D\&A_t - Cap\ Exp_t - Add\ WC_t \\ &= [EBIT_t \times (1 - t)] + D\&A_t - Cap\ Exp_t - Add\ WC_t, \end{aligned}$$

solving for $EBIT_t$ yields:

$$\begin{aligned} EBIT_t &= (FCF_t - D\&A_t + Cap\ Exp_t + Add\ WC_t)/(1 - t) \\ &= (\$14{,}343 - \$10{,}000 + \$0 + \$2{,}000)/(1 - 0.35) = \$9{,}758. \end{aligned}$$

This is the EBIT that corresponds to the FCF at which the project NPV = \$0.

3. We next use $EBIT_t$ to calculate the amount by which revenue exceeds VC. Recall from our discussion of variable and fixed costs that:

$$EBIT = Revenue - VC - FC - D\&A$$

Rearranging this formula and solving for Revenue minus VC yields:

$$Revenue - VC = EBIT + D\&A + FC = \$9{,}758 + \$10{,}000 + \$35{,}000 = \$54{,}758$$

where the FC of \$35,000 is from Exhibit 12.1. The difference between Revenue and VC is the **total contribution** of the project. This is the amount that the project contributes to help pay its fixed costs, after covering all of its variable costs.

total contribution the total amount that a project contributes to help pay its fixed costs after covering all of its variable costs

4. Finally, to compute the economic break-even point, we simply divide the total contribution by the per-unit contribution that we previously calculated to be \$9. Doing this, we find that the economic break-even point is

$$\begin{aligned} Economic\ Break\text{-}even_{Automated} &= (Revenue - VC)/Unit\ contribution \\ &= \$54{,}758/\$9\ per\ unit = 6{,}084\ units \end{aligned}$$

This value tells us that if 6,084 units are sold each year over the life of the automated production alternative for the hammock-manufacturing business and the unit price and cost estimates are correct, the NPV of the project will equal \$0. Any unit sales above this amount will result in an **economic profit**—a profit that exceeds the opportunity cost of the capital invested in a project.

economic profit a profit that exceeds the opportunity cost of the capital invested in a project

To make sure we understand the economic break-even point calculation, let's also do it for the manual production alternative for the hammock-manufacturing business.

For this calculation, we will assume that the project has a four-year life, that the initial investment is \$4,000, that the salvage value is expected to equal \$0, that the annual capital expenditures will equal \$0, that annual additions to working capital will equal \$2,000, that the firm's marginal tax rate is 35 percent, and that the opportunity cost of capital for the project is 10 percent.

1. $$\begin{aligned} PV(Net\ nonrecurring\ investments) &= \$4{,}000 + \$8{,}000/(1.1)^4 \\ &= \$9{,}464 \end{aligned}$$

The life of the project is four years, and the opportunity cost of capital is 10 percent. Therefore the annual FCF at which the manual alternative would have an NPV of \$0 is:

$$\begin{aligned} \$9{,}464 &= \frac{FCF_t}{0.10}\left[1 - \frac{1}{(1 + 0.10)^4}\right] \\ FCF_t &= \$2{,}986 \end{aligned}$$

2. $$\begin{aligned} EBIT_t &= (FCF_t - D\&A_t + Cap\ Exp_t + Add\ WC_t)/(1 - t) \\ &= (\$2{,}986 - 1{,}000 + \$0 + \$2{,}000)/(1 - 0.35) = \$6{,}132 \end{aligned}$$

3. $$\begin{aligned} Revenue_t - VC_t &= EBIT_t + D\&A_t + FC_t \\ &= \$6{,}132 + \$1{,}000 + \$4{,}000 = \$11{,}132 \end{aligned}$$

4. $$\begin{aligned} Economic\ Break\text{-}even_{Manual} &= (Revenue - VC)/Unit\ contribution \\ &= \$11{,}132/\$5\ per\ unit = 2{,}226\ units \end{aligned}$$

The number of units that must be sold in order for investors to earn the opportunity cost of capital (i.e., to achieve a $0 NPV) with the manual production alternative is substantially smaller than the number of units that must be sold if the automated production alternative is chosen (2,226 units versus 6,084 units). Of course, as we discussed earlier, the automated production alternative has the potential to generate substantially higher profits and greater value for investors with high levels of unit sales because it has greater operating leverage.

Learning by Doing Application 12.6 illustrates another economic break-even point calculation.

LEARNING BY DOING

APPLICATION 12.6 | Calculating the Economic Break-Even Point

Problem The opportunity cost of capital for the in-home computer support business you are starting is 8 percent, and you expect to operate the business for five years before shutting it down. Assume that the assets you acquire with the $100,000 initial investment will have no salvage value in five years and that annual capital expenditures and additions to working capital will both equal $0 in each of the next five years. In other words, the business will not require any investment beyond the initial $100,000. Finally, assume that you expect your marginal tax rate to be 20 percent over the next five years. What is the economic break-even number of house calls per year?

Approach Follow the four-step procedure described in the text.

Solution

1. The present value of the net nonrecurring investments required for the business is $100,000, the life of the business is five years, and the opportunity cost of capital is 8 percent. Using the formula for the present value of an annuity, the annual FCF at which the business will have an NPV of $0 is:

$$\text{PV(FCF)} = \frac{\text{FCF}_t}{k}\left[1 - \frac{1}{(1+k)^n}\right]$$

$$\$100{,}000 = \frac{\text{FCF}_t}{0.08}\left[1 - \frac{1}{(1+0.08)^5}\right]$$

$$\text{FCF}_t = \$25{,}046$$

2. With FCF_t of $25,046, annual D&A of $12,000, annual FC of $36,000 (monthly D&A and FC are given in Learning by Doing Application 12.1), Cap Expt of $0, Add WC_t of $0, and a marginal tax rate of 20 percent, the break-even EBIT_t is:

$$\begin{aligned}\text{EBIT}_t &= (\text{FCF}_t - \text{D\&A}_t + \text{Cap Exp}_t + \text{Add WC}_t)/(1-t)\\ &= (\$25{,}046 - \$12{,}000 + \$0 + \$0)/(1 - 0.20) = \$16{,}308\end{aligned}$$

3. The total contribution is therefore:

$$\begin{aligned}\text{Revenue}_t - \text{VC}_t &= \text{EBIT}_t + \text{D\&A}_t + \text{FC}_t\\ &= \$16{,}308 + \$12{,}000 + \$36{,}000 = \$64{,}308\end{aligned}$$

4. The economic break-even level of unit sales is calculated by dividing the total contribution by the contribution per house call of $50 ($70 of Revenue per house call − $20 unit VC):

$$\begin{aligned}\text{Economic Break-even} &= (\text{Revenue} - \text{VC})/\text{Unit contribution}\\ &= \$64{,}308/\$50 = 1{,}286.2 \text{ house calls per year}\end{aligned}$$

If your business makes 1,286.2 house calls per year, it will earn the 8 percent opportunity cost of capital and have an NPV of $0. The NPV will be positive if the annual number of house calls is greater than 1,286.2 and negative if the number of house calls is smaller.

EXHIBIT 12.8 **Incremental Free Cash Flows and NPV for the Automated Production Alternative for the Hammock-Manufacturing Business**

This exhibit shows the calculation of the yearly incremental pretax free cash flows (FCF) and the NPV of the automated production alternative in the hammock-manufacturing example assuming the project has a four-year life. The FCF calculation is illustrated in Exhibit 11.1.

Assumptions:

Opportunity cost of capital	10%	Initial investment	$40,000
Unit sales	10,000	D&A	$10,000
Unit price	$25	Annual Cap Exp	$8,000
Unit VC	$16	Add WC	$2,000
FC	$35,000	Tax Rate	35%

	Year				
	0	1	2	3	4
Revenue		$250,000	$250,000	$250,000	$250,000
− VC		160,000	160,000	160,000	160,000
− FC		35,000	35,000	35,000	35,000
EBITDA		$ 55,000	$ 55,000	$ 55,000	$ 55,000
− D&A		10,000	10,000	10,000	10,000
EBIT		$ 45,000	$ 45,000	$ 45,000	$ 45,000
− Taxes		15,750	15,750	15,750	15,750
NOPAT		$ 29,250	$ 29,250	$ 29,250	$ 29,250
+ D&A		10,000	10,000	10,000	10,000
CF Opns		$ 39,250	$ 39,250	$ 39,250	$ 39,250
− Cap Ex	$40,000	8,000	8,000	8,000	8,000
− Add WC		2,000	2,000	2,000	2,000
= FCF	($40,000)	$ 29,250	$ 29,250	$ 29,250	$ 29,250
NPV	$52,719				

EXHIBIT 12.9 **NPV Values for the Automated Production Alternative for the Hammock-Manufacturing Business for Three Scenarios**

Different economic scenarios result in different NPV estimates for the automated production alternative in the hammock-manufacturing example. The expected unit sales, unit prices, and unit variable costs vary depending on economic conditions.

Economic Conditions	Unit Sales	Unit Price	Unit Variable Costs	NPV
Strong	12,000	$28	$17	$139,256
Expected	10,000	$25	$16	$52,719
Weak	8,000	$22	$15	($17,335)

Figure 12.6

$$\text{Expected unit sales} = (0.25 \times 12{,}000) + (0.50 \times 10{,}000) + (0.25 \times 8{,}000) = 10{,}000 \text{ units}$$

$$\text{Expected unit price} = (0.25 \times \$28) + (0.50 \times \$25) + (0.25 \times \$22) = \$25$$

$$\text{Expected unit variable costs} = (0.25 \times \$17) + (0.50 \times \$16) + (0.25 \times \$15) = \$16$$

Summary of Key Equations

Equation	Description	Formula
12.1	Op Ex in terms of incremental variable and fixed costs	$\text{Op Ex} = \text{VC} + \text{FC}$
12.2	Degree of pretax cash flow operating leverage	$\text{Cash Flow DOL} = 1 + \frac{\text{FC}}{\text{EBITDA}}$
12.3	Degree of accounting operating leverage	$\text{Accounting DOL} = 1 + \frac{\text{FC} + \text{D\&A}}{\text{EBIT}}$
12.4	Pretax operating cash flow (EBITDA) break-even point	$\text{EBITDA Break-even} = \frac{\text{FC}}{\text{Price} - \text{Unit VC}}$
12.5	Crossover level of unit sales for EBITDA	$\text{CO}_{\text{EBITDA}} = \frac{\text{FC}_{\text{Alternative 1}} - \text{FC}_{\text{Alternative 2}}}{\text{Unit contribution}_{\text{Alternative 1}} - \text{Unit contribution}_{\text{Alternative 2}}}$
12.6	Accounting operating profit (EBIT) break-even point	$\text{EBIT Break-even} = \frac{\text{FC} + \text{D\&A}}{\text{Price} - \text{Unit VC}}$
12.7	Crossover level of unit sales of EBIT	$\text{CO}_{\text{EBIT}} = \frac{(\text{FC} + \text{D\&A})_{\text{Alternative 1}} - (\text{FC} + \text{D\&A})_{\text{Alternative 2}}}{\text{Unit contribution}_{\text{Alternative 1}} - \text{Unit contribution}_{\text{Alternative 2}}}$

Self-Study Problems

12.1 The Yellow Shelf Company sells all of its shelves for $100 per shelf and incurs $50 in variable costs to produce each. If the fixed costs for the firm are $2,000,000 per year, what will the EBIT for the firm be if it produces and sells 45,000 shelves next year? Assume that depreciation and amortization is included in the fixed costs.

12.2 Hydrogen Batteries sells its specialty automobile batteries for $85 each, while its current variable cost per unit is $65. Total fixed costs (including depreciation and amortization expense) are $150,000 per year. Management expects to sell 10,000 batteries next year but is concerned that variable cost will increase next year due to material cost increases. What is the maximum variable cost per unit increase that will keep the EBIT from becoming negative?

12.3 The Vinyl CD Co. is going to take on a project that is expected to increase its EBIT by $90,000, its fixed cost cash expenditures by $100,000, and its depreciation and amortization by $80,000 next year. If the project yields an additional 10 percent in revenue, what percentage increase in the project's EBIT will result from the additional revenue?

12.4 You are considering investing in a business that has monthly fixed costs of $5,500 and sells a single product that costs $35 per unit to make. This product sells for $90 per unit. What is the annual pretax operating cash flow break-even point for this business?

12.5 Belt Bottoms, Inc., is considering a five-year project with an initial investment of $20,000. What annual free cash flow (FCF) would be required for this project to have an NPV of $0 if the opportunity cost capital is 11 percent?

Solutions to Self-Study Problems

12.1 The calculations for Yellow Shelf are as follows:

Revenue	$100 × 45,000 =	$4,500,000
VC	$50 × 45,000 =	2,250,000
FC + D&A		2,000,000
EBIT		$ 250,000

12.2 The forecasted EBIT for Hydrogen Batteries is:

Revenue	$85 × 10,000 =	$850,000
VC	$65 × 10,000 =	650,000
FC + D&A		150,000
EBIT		$ 50,000

Therefore, total variable cost may increase by $50,000, which means that if the firm produces and sells 10,000 batteries, then the variable cost per unit may increase by $5 ($50,000/10,000 units = $5 per unit).

12.3 $$\text{Accounting DOL} = 1 + \frac{\text{FC} + \text{D\&A}}{\text{EBIT}} = 1 + \frac{\$100{,}000 + \$80{,}000}{\$90{,}000} = 3$$

Therefore, a 10 percent additional increase in revenue should result in approximately a 30 percent increase in EBIT.

12.4 You can solve for the *monthly* pretax operating cash flow break-even point using Equation 12.4:

$$\text{EBITDA Break-even} = \frac{\text{FC}}{\text{Price} - \text{Unit VC}} = \frac{\$5{,}500}{\$90 - \$35} = 100 \text{ units per month}$$

Therefore, the annual EBITDA break-even point is 100 units per month × 12 months per year = 1,200 units.

12.5 If the FCF is equal in each of the five years, then we can solve for FCF using the present value of an ordinary annuity formula:

$$\$20{,}000 = \frac{\text{FCF}_t}{0.11} \times \left(1 - \frac{1}{(1.11)^5}\right) \Rightarrow \text{FCF} = \$5{,}411.41$$

Discussion Questions

12.1 You are involved in the planning process for a firm that is expected to have a large increase in sales next year. Which type of firm would benefit more from that sales increase: a firm with low fixed costs and high variable costs or a firm with high fixed costs and low variable costs?

12.2 You own a firm with a single new product that is about to be introduced to the public for the first time. Your marketing analysis suggests that the annual demand for this product could be anywhere between 500,000 units and 5,000,000 units. Given such a wide range, discuss the safest cost structure alternative for your firm.

12.3 Discuss the interpretation of the degree of accounting operating leverage and degree of pretax cash flow operating leverage.

12.4 Explain how EBITDA differs from incremental after-tax free cash flows (FCF) and discuss the types of businesses for which this difference would be especially small or large.

12.5 Describe how the pretax operating cash flow break-even point is related to the economic break-even point.

12.6 Is it possible to have a crossover point where the accounting break-even point is the same for two alternatives—that is, above the break-even point for a low-fixed-cost alternative but below the break-even point for a high-fixed-cost alternative? Explain.

12.7 What is the fundamental difference between a sensitivity analysis and a scenario analysis?

12.8 The economic break-even calculation assumes that the number of units sold is the same each year during the life of the project. Is it possible for the NPV of a project to be negative if unit sales are not the same each year and the average unit sales are higher than that estimated using the economic break-even calculation? Explain.

12.9 How does the pretax operating cash flow for a project differ from the economic profit for the project?

12.10 What is the advantage of using a simulation analysis instead of a scenario analysis to assess the risk of a project?

Questions and Problems

Basic

12.1 **Fixed and variable costs:** Define *variable costs* and *fixed costs,* and give an example of each.

12.2 **EBIT:** Describe the role that the mix of variable versus fixed costs has in the variation of earnings before interest and taxes (EBIT) for a firm.

12.3 **EBIT:** The Generic Publications Textbook Company sells all of its books for $100 per book, and it currently costs $50 in variable costs to produce each text. The fixed costs, which include depreciation and amortization for the firm, are currently $2 million per year. Management is considering changing the firm's production technology, which will increase the fixed costs for the firm by 50 percent

but decrease the variable costs per unit by 50 percent. If management expects to sell 45,000 books next year, should they switch technologies?

12.4 EBIT: WalkAbout Kangaroo Shoe Stores management forecasts that it will sell 9,500 pairs of shoes next year. The firm buys its shoes for $50 per pair from the wholesaler and sells them for $75 per pair. If the firm will incur fixed costs plus depreciation and amortization of $100,000, then what is the percent increase in EBIT if the actual sales next year equal 11,500 pairs of shoes instead of 9,500?

12.5 Cash Flow DOL: The law firm of Dewey, Cheatem, and Howe has monthly fixed costs of $100,000, EBIT of $250,000, and depreciation charges on its office furniture and computers of $5,000. Calculate the Cash Flow DOL for this firm.

12.6 Cash Flow DOL: The degree of pretax cash flow operating leverage at Rackit Corporation is 2.7 when it sells 100,000 units of its new tennis racket and its EBITDA is $95,000. Ignoring the effects of taxes, what are the fixed costs for Rackit Corporation?

12.7 Accounting DOL: Explain how the value of the degree of accounting operating leverage can be used.

12.8 Accounting DOL: Caterpillar, Inc., is a manufacturer of large earth-moving and mining equipment. This firm and other heavy equipment manufacturers have degrees of accounting operating leverage that are relatively high. Explain why.

12.9 Break-even analysis: Why is the per-unit contribution important in a break-even analysis?

12.10 Break-even analysis: Calculate the accounting operating profit break-even point and pretax operating cash flow break-even point for each of the three production choices outlined below.

Choice	Price	Unit VC	FC	D&A
A	$250	$160	$15,000	$3,000
B	$55	$10	$1,100	$200
C	$10	$1.50	$100	$100

12.11 Break-even point: The accounting operating profit break-even point tells us the number of units that must be sold for a firm to break even in a given year from an accounting operating profit perspective. What measure tells us the number of units that must be sold each year during the life of a project in order for the project to break even with regard to its opportunity cost of capital?

12.12 Simulation analysis: What is simulation analysis, and how is it used?

Intermediate

12.13 EBIT: If a manufacturing firm and a service firm have identical cash fixed costs, but the manufacturing firm has much higher depreciation and amortization, then which firm is more likely to have a large discrepancy between its FCF and its EBIT?

12.14 EBIT: Duplicate Footballs, Inc., management expects to sell 15,000 balls this year. The balls sell for $110 each and have a variable cost per unit of $80. Fixed costs, including depreciation and amortization, are currently $220,000 per year. How much can either the fixed costs or the variable cost per unit increase before the company has a negative EBIT?

12.15 EBIT: Specialty Light Bulbs management anticipates selling 3,000 light bulbs this year at a price of $15 per bulb. It costs Specialty $10 in variable costs to produce each light bulb, and the fixed costs for the firm are $10,000. Specialty has an opportunity to sell an additional 1,000 bulbs next year at the same price and variable cost, but by doing so the firm will incur an additional fixed cost of $4,000. Should Specialty produce and sell the additional bulbs?

12.16 Cash Flow DOL: The pretax operating cash flow of Memphis Motors declined so much during the recession of 2008 and 2009 that the company almost defaulted on its debt. The owner of the company wants to change the cost structure of his business so that this does not happen again. He has been able to reduce fixed costs from $500,000 to $300,000 and, in doing so, reduce the Cash Flow DOL for Memphis Motors from 3.0 to 2.2 with sales of $1,000,000 and pretax operating cash flow of $250,000. If sales declined by 20 percent from this level, how much more pretax operating cash flow would Memphis Motors have with the new cost structure than under the old?

12.17 Cash Flow DOL: For the Vinyl CD Co. in Self-Study Problem 12.3, what percentage increase in pretax operating cash flow will be driven by the additional revenue?

Use the following information for Problems 12.18, 12.19, and 12.20:

Dandle's Candles will be producing a new line of dripless candles in the coming year and has the choice of producing the candles in a large factory with a small number of workers or a small factory with a large number of workers. Each candle will be sold for $10. If the large factory is chosen, the cost per unit to produce each candle will be $2.50. The cost per unit will be $7.50 in the small factory. The large factory would have fixed cash costs of $2 million and a depreciation expense of $300,000 per year, while those expenses would be $500,000 and $100,000, respectively, in the small factory.

12.18 Accounting operating profit break-even: Calculate the accounting operating profit break-even point for both factory choices for Dandle's Candles.

12.19 Crossover level of unit sales: Calculate the number of candles for which the accounting operating profit at Dandle's Candles is the same regardless of the factory choice.

12.20 Pretax operating cash flow break-even: Calculate the pretax operating cash flow break-even point for both factory choices for Dandle's Candles.

12.21 Accounting and cash flow break-even: Your analysis tells you that at a projected level of sales, a project your firm is considering will be below accounting break-even but above cash flow break-even. Explain why this might still be a viable project or firm.

12.22 Economic break-even point: Management of March and Dine Inc. has estimated that the firm's new TV dinner project must generate $10,200 in FCF during each of the next six years to have an NPV of $0. Management anticipates that depreciation and amortization charges will equal $3,000, capital expenditures will equal

$2,000, and additions to working capital will equal $500 during each of those years. What level of EBIT corresponds to an annual FCF of $10,200 if the firm is subject to the 30 percent marginal tax rate?

12.23 Economic break-even point: Rose Weiser Company management is considering a project that will require an initial investment of $50,000 and will last for 10 years. No other capital expenditures or increases in working capital are anticipated during the life of the project. What is the annual EBIT that will make the project economically viable if the cost of capital for the project is 9 percent and the firm will depreciate the investment using straight-line depreciation and a salvage value of $0? Assume that the marginal tax rate is 40 percent.

12.24 Economic break-even point: The BowGus Archery Company management estimates that its new Galactically Flexible Bow project will have to generate EBIT of $20,000 each year to be viable. The project's fixed cash expenses are expected to equal $8,000, and its depreciation and amortization expenses are expected to be $5,000 each year. If the Galactically Flexible bows are expected to sell for $150 each and the variable cost to produce each bow is expected to be $100, then how many of these bows must the firm produce and sell each year to generate annual EBIT of $20,000?

12.25 Sensitivity and scenario analyses: Sensitivity analysis and scenario analysis are somewhat similar. Describe which is a more realistic method of analyzing the impact of different scenarios on a project.

12.26 Sensitivity analysis: Describe the circumstances under which sensitivity analysis might be a reasonable basis for determining changes to a firm's EBIT or FCF.

12.27 Scenario analysis: Chip's Home Brew Whiskey management forecasts that if the firm sells each bottle of Snake-Bite for $20, then the demand for the product will be 15,000 bottles per year. Sales will equal only 90 percent of this amount if the price is raised 10 percent. Chip's variable cost per bottle is $10, and the total fixed cash cost for the year is $100,000. Depreciation and amortization charges are $20,000, and the firm has a 30 percent marginal tax rate. Management anticipates an increased working capital need of $3,000 for the year. What will be the effect of a 10 percent price increase on the firm's FCF for the year?

12.28 Sensitivity, scenario, and simulation analysis: If you were interested in calculating the probability that a project will have a positive FCF, what type of risk analysis tool would you most likely use?

Advanced

12.29 Mick's Soft Lemonade is starting to develop a new product for which the cash fixed costs are expected to be $80,000. The projected EBIT is $100,000, and the Accounting DOL is expected to be 2.0. What is the Cash Flow DOL?

12.30 If a firm has a fixed asset base, meaning that its depreciation and amortization for any year is positive, discuss the relation between its Accounting DOL and its Cash Flow DOL.

12.31 Silver Polygon, Inc. management has determined that if revenues were to increase by 10 percent, then EBIT would increase by 25 percent to $100,000. The fixed costs (cash only) for the firm are $100,000. Given the same 10 percent increase in revenues, what would be the corresponding change in EBITDA?

12.32 If a firm's costs (both variable as well as fixed) are known with certainty, then what are the only two sources of volatility for the firm's operating profits or its operating cash flows?

12.33 In most circumstances, given the choice between a higher fixed-cost structure and a lower fixed cost structure, which of the two would generate a larger contribution margin?

12.34 Using the same logic as with the accounting break-even calculation in Problem 12.19, adapt the formula for the crossover level of unit sales to find the number of units sold where the pretax operating cash flow is the same whether the firm chooses the large or small factory.

12.35 You are the project manager for Eagle Golf Corporation. You are considering manufacturing a new golf wedge with a unique groove design. You have put together the estimates in the following table about the potential demand for the new club and the associated selling and manufacturing prices. You expect to sell the club for five years. The equipment required for the manufacturing process can be depreciated using straight-line depreciation over five years and will have a zero salvage value at the end of the project's life. No additional capital expenditures are required. No new working capital is needed for the project. The required return for projects of this type is 12 percent and the company has a 35 percent marginal tax rate. You estimate that there is a 50 percent chance the project will achieve the expected sales and a 25 percent chance it will achieve either the weak or strong sales outcomes. Should you recommend the project?

	Strong Sales	Expected Sales	Weak Sales
Units sold	15,000	10,000	7,000
Selling price per unit	$130	$120	$110
Variable costs per unit	$70	$65	$60
Fixed costs	$1,290,000	$1,290,000	$1,290,000
Initial investment	$1,400,000	$1,400,000	$1,400,000

12.36 Commodore Motors management is considering a project to produce toy cars. The project would require an initial outlay of $100,000 and have an expected life of 10 years. Management estimates that each year during the life of the project depreciation and amortization would be $8,000, capital expenditures would be $4,000, additions to working capital would be $2,000, and fixed costs would be $3,000. Also, each toy car would sell for $15 and cost $7 to produce. Finally, the cost of capital for the project would be 12 percent, cash flow from the project would be taxed at a 25 percent rate, and the assets would be depreciated to a salvage value of $0. How many units must be sold each year in order for this project to break even from an economic standpoint?

CFA Problems

12.37 Operating leverage is a measure of the:

a. Sensitivity of net earnings to changes in operating earnings.

b. Sensitivity of net earnings to changes in sales.

c. Sensitivity of fixed operating costs to changes in variable costs.

d. Sensitivity of earnings before interest and taxes to changes in the number of units produced and sold.

12.38 The Fulcrum Company produces decorative swivel platforms for home televisions. If Fulcrum produces 40 million units, it estimates that it can sell them for $100 each. The variable production costs are $65 per unit, whereas the fixed production costs are $1.05 billion. Which of the following statements is true?

a. The Fulcrum Company produces a positive operating income if it produces and sells more than 25 million swivel platforms.

b. The Fulcrum Company's degree of operating leverage is 1.333.

c. If the Fulcrum Company increases production and sales by 5 percent, its operating earnings are expected to increase by 20 percent.

d. Increasing the fixed production costs by 10 percent will result in a lower sensitivity of operating earnings to changes in units produced and sold.

Sample Test Problems

12.1 Retro Inc. sells vintage football jerseys for $72 each. Variable costs are $58 per unit and total fixed costs (including depreciation and amortization expense) are $84,000 per year. If sales for next year are expected to equal 8,000 jerseys, how much can variable costs per unit increase without EBIT becoming negative?

12.2 How would a capital-intensive company fare during good and poor economic times as compared with less capital-intensive companies? Explain.

12.3 The manager of Roy's Restaurant has determined that if revenues were to increase by 20 percent, then EBIT would increase by 45 percent to $87,000. What would be the corresponding change in EBITDA if revenues increased 20 percent and cash fixed costs are $35,000?

12.4 Luminosity Inc. produces modern light fixtures that sell for $150 per unit. The firm's management is considering purchasing a high-capacity manufacturing machine. If the high-capacity machine is purchased, then the firm's annual cash fixed costs will be $60,000 per year, variable costs will be $55 per unit, and annual depreciation and amortization expenses will equal $30,000. If the machine is not purchased, annual cash fixed costs will be $25,000, variable costs will be $105 per unit, and annual depreciation and amortization expenses will equal $10,000. What is the minimum level of unit sales necessary in order for EBIT with the high-capacity machine to be higher than EBIT without that machine?

12.5 Paper Christmas Trees Inc. management is considering introducing a new line of inexpensive Christmas trees. The initial outlay for the project is $175,000, and the company will have to invest $5,000 in working capital and $10,000 in fixed assets each year during the six-year life of the project. The initial outlay will be depreciated assuming a salvage value of $0. Annual depreciation and amortization charges for the project will be $15,000, and cash-related fixed costs will be $6,000 per year. The firm will sell each tree for $75, and the variable cost to produce each tree will be $40. Calculate the number of trees that the firm must produce and sell in order to break even economically. Assume that the appropriate cost of capital for the project is 15 percent and that the marginal tax rate for the firm is 40 percent.

Figure 13.1

$$E(R_i) = R_{rf} + \beta_i [E(R_m) - R_{rf}]$$

$$\text{MV of assets} = \text{MV of liabilities} + \text{MV of equity} \tag{13.1}$$

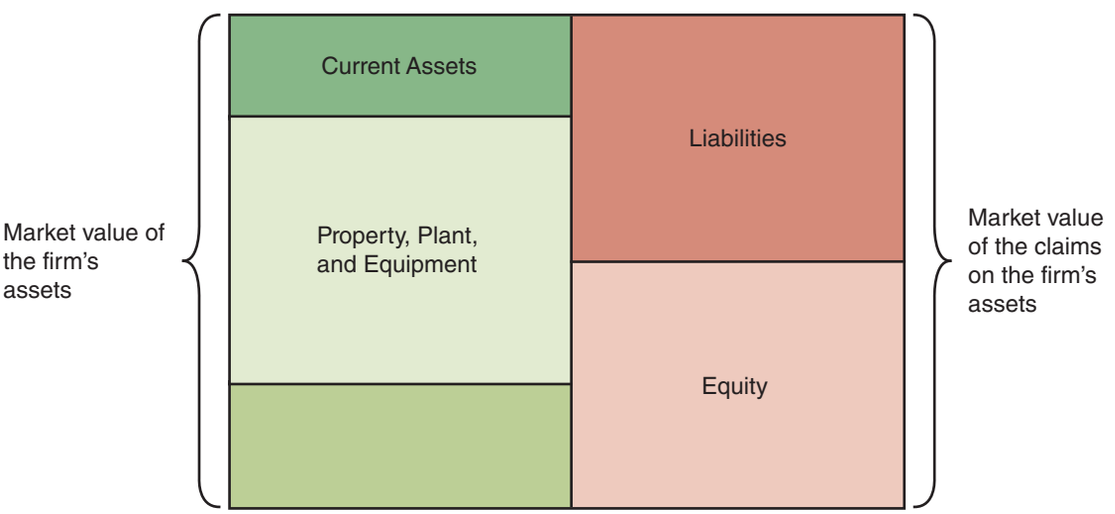


EXHIBIT 13.1 **The Finance Balance Sheet**

The market value of a firm's assets, which equals the present value of the cash flows those assets are expected to generate in the future, must equal the market value of the claims on those cash flows—the firm's liabilities and equity.

Figure 13.2

$$\beta_{n\ \text{Asset portfolio}} = \sum_{i=1}^{n} x_i \beta_i = x_1\beta_1 + x_2\beta_2 + x_3\beta_3 + \cdots + x_n\beta_n$$

Figure 13.3

$$E(R_i) = R_{rf} + \beta_i [E(R_m) - R_{rf}]$$

$$k_{\text{Firm}} = \sum_{i=1}^{n} x_i k_i = x_1 k_1 + x_2 k_2 + x_3 k_3 + \cdots + x_n k_n \qquad (13.2)$$

LEARNING BY DOING

APPLICATION 13.1 | Calculating the Cost of Capital for a Firm

Problem You are considering purchasing a rug cleaning company that will cost $2,000,000. You plan to finance the purchase with a $1,500,000 loan from Bank of America (BofA) that has a 6.5 percent interest rate, a $300,000 loan from the seller of the company that has an 8 percent interest rate, and $200,000 of your own money. You will own all of the equity (stock) in the firm. You estimate that the opportunity cost of your $200,000 investment—that is, what you could earn on an investment of similar risk in the capital market—is 12 percent with that much debt. What is the cost of capital for this investment?

Approach You can use Equation 13.2 to calculate the WACC for this firm. Since you are planning to finance the purchase using capital from three different sources—two loans and your own equity investment—the right-hand side of Equation 13.2 will have three terms.

Solution We begin by calculating the weights for the different types of financing:

$$\begin{aligned} x_{\text{BofA Loan}} &= \$1{,}500{,}000/\$2{,}000{,}000 = 0.75 \\ x_{\text{Seller loan}} &= \$300{,}000/\$2{,}000{,}000 = 0.15 \\ x_{\text{Equity}} &= \$200{,}000/\$2{,}000{,}000 = 0.10 \end{aligned}$$

where $x_{\text{BofA loan}} + x_{\text{Seller loan}} + x_{\text{Equity}} = 0.75 + 0.15 + 0.10 = 1.00$.

We can then calculate the WACC using Equation 13.2:

$$\begin{aligned} \text{WACC} = k_{\text{Firm}} &= x_{\text{BofA loan}} k_{\text{BofA loan}} + x_{\text{Seller loan}} k_{\text{Seller loan}} + x_{\text{Equity}} k_{\text{Equity}} \\ &= (0.75)(0.065) + (0.15)(0.08) + (0.10)(0.12) \\ &= 0.728, \text{ or } 7.28\% \end{aligned}$$

On average, you would be paying 7.28 percent per year on every dollar you invested in the firm. This is the opportunity cost of capital for the firm. It is the rate that you would use to discount the cash flows associated with the rug cleaning business in an NPV analysis.

Figure 13.4

$$P_B = \frac{C_1}{1+i} + \frac{C_2}{(1+i)^2} + \cdots + \frac{C_n + F_n}{(1+i)^n}$$

$$\$1{,}042.65 = \frac{\$35}{1+i} + \frac{\$35}{(1+i)^2} + \frac{\$35}{(1+i)^3} + \cdots + \frac{\$35}{(1+i)^9} + \frac{\$1{,}035}{(1+i)^{10}}$$

Figure 13.5

$$\text{EAR} = \left(1 + \frac{\text{Quoted interest rate}}{m}\right)^{m} - 1 = \left(1 + \frac{0.06}{2}\right)^{2} - 1$$
$$= (1.03)^2 - 1 = 0.0609, \text{ or } 6.09\%$$

Figure 13.6

$$P_B = \frac{C_1}{1+i} + \frac{C_2}{(1+i)^2} + \cdots + \frac{C_n + F_n}{(1+i)^n}$$
$$\$1{,}021.80 = \frac{\$35}{1+i} + \frac{\$35}{(1+i)^2} + \frac{\$35}{(1+i)^3} + \cdots + \frac{\$35}{(1+i)^9} + \frac{\$1{,}035}{(1+i)^{10}}$$
$$i = k_{\text{Bond}} = 0.0324, \text{ or } 3.24\%$$

$$k_{\text{Debt after-tax}} = k_{\text{Debt pretax}} \times (1 - t) \qquad (13.3)$$

Figure 13.7

$$k_{\text{Debt after-tax}} = k_{\text{Debt pretax}} \times (1 - t) = 0.06 \times (1 - 0.2) = 0.0480, \text{ or } 4.80\%$$

Figure 13.8

$$P_B = \frac{C_1}{1+i} + \frac{C_2}{(1+i)^2} + \cdots + \frac{C_n + F_n}{(1+i)^n}$$
$$\$1{,}026.24 = \frac{\$80}{1+i} + \frac{\$80}{(1+i)^2} + \frac{\$1{,}080}{(1+i)^3}$$
$$i = k_{\text{Bond pretax}} = 0.0700, \text{ or } 7.00\%$$

Figure 13.9

$$x_{\text{Bonds}} = \$25{,}656{,}000/(\$25{,}656{,}000 + \$5{,}000{,}000) = 0.8369$$
$$x_{\text{Bank debt}} = \$5{,}000{,}000/(\$25{,}000{,}000 + \$5{,}000{,}000) = 0.1631$$
$$\text{where } x_{\text{Bonds}} + x_{\text{Bank debt}} = 0.8369 + 0.1631 = 1.000$$

LEARNING BY DOING

APPLICATION 13.2 | Calculating the After-Tax Cost of Debt for a Firm

Problem You have just successfully completed a leveraged buyout of the firm that you have been working for. To finance this $35 million transaction, you and three partners put up a total of $10 million in equity capital, and you borrowed $25 million from banks and other investors. The bank debt consists of $10 million of secured debt borrowed at a rate of 6 percent from Bank of America and $7 million of senior unsecured debt borrowed at a rate of 7 percent from JPMorgan Chase. The remaining $8 million was borrowed from an investment group managed by a private equity firm. The rate on this subordinated (junior) unsecured debt is 9.5 percent. What is the overall after-tax cost of the debt financing used to buy the firm if you expect the firm's average and marginal tax rates to both be 25 percent?

Approach The overall after-tax cost of debt can be calculated using the following three-step process: (1) Calculate the fraction of the total debt (weight) for each individual debt issue. (2) Using these weights, calculate the weighted average pretax cost of debt. (3) Use Equation 13.3 to calculate the after-tax average cost of debt.

Solution

(1) The weights for the three types of debt are as follows:

$$x_{\text{Secured debt}} = \$10{,}000{,}000/\$25{,}000{,}000 = 0.40$$
$$x_{\text{Senior unsecured debt}} = \$\ 7{,}000{,}000/\$25{,}000{,}000 = 0.28$$
$$x_{\text{Subordinated unsecured debt}} = \$\ 8{,}000{,}000/\$25{,}000{,}000 = 0.32$$
$$\text{where } x_{\text{Secured debt}} + x_{\text{Senior unsecured debt}} + x_{\text{Subordinated unsecured debt}} = 0.40 + 0.28 + 0.32 = 1.00$$

(2) The weighted average pretax cost of debt is:

$$\begin{aligned} k_{\text{Debt pretax}} &= x_{\text{Secured debt}} k_{\text{Secured debt pretax}} + x_{\text{Senior unsecured debt}} k_{\text{Senior unsecured debt pretax}} \\ &\quad + x_{\text{Subordinated unsecured debt}} k_{\text{Subordinated unsecured debt pretax}} \\ &= (0.40)(0.06) + (0.28)(0.07) + (0.32)(0.095) \\ &= 0.0740, \text{ or } 7.40\% \end{aligned}$$

(3) The after-tax cost of debt is therefore:

$$k_{\text{Debt after-tax}} = k_{\text{Debt pretax}} \times (1 - t) = 7.40\% \times (1 - 0.25) = 5.55\%$$

DECISION MAKING

EXAMPLE 13.1 | Using the Cost of Debt in Decision Making

Situation Your pizza parlor business has developed such a strong reputation that you have decided to take advantage of the restaurant's name recognition by selling frozen pizzas through grocery stores. In order to do this, you will have to build a manufacturing facility. You estimate that this will cost you $10 million. Since your business currently has only $2 million in the bank, you will have to borrow the remaining $8 million. You have spoken with two bankers about possible loan packages. The banker from Easy Money Financial Services offered you a loan for $6 million with a 6 percent rate and $2 million with a 7.5 percent rate. You calculate the pretax cost of debt for this package to be:

$$\begin{aligned} k_{\text{Loans pretax}} &= (\$6{,}000{,}000/\$8{,}000{,}000)(0.06) + (\$2{,}000{,}000/\$8{,}000{,}000)(0.075) \\ &= 0.0450 + 0.0188 \\ &= 0.0638, \text{ or } 6.38\% \end{aligned}$$

Your local banker offered you a single $8 million loan for 6.35 percent. Which financing should you choose if all terms on all of the loans, other than the interest rates, are the same?

Decision This is an easy decision. You should choose the less expensive alternative—the loan from your local bank. In this example, you can directly compare the pretax costs of the two alternatives. You do not need to calculate the after-tax costs because multiplying each pretax cost by the same number, $1 - t$, will not change your decision.

Figure 13.10

$$E(R_i) = R_{rf} + \beta_i [E(R_m) - R_{rf}]$$

$$k_{cs} = R_{rf} + (\beta_{cs} \times \text{Market risk premium}) \qquad (13.4)$$

Figure 13.11

$$\begin{aligned} k_{cs} &= R_{rf} + (\beta_{cs} \times \text{Market risk premium}) \\ &= 0.0288 + (1.19 \times 0.0592) = 0.0992, \text{ or } 9.92\% \end{aligned}$$

Figure 13.12

$$P_0 = \frac{D_1}{R - g}$$

APPLICATION 13.3 | Calculating the Cost of Common Stock Using a Stock's Beta

LEARNING BY DOING

Problem You have decided to estimate the cost of the common stock in your pizza business on December 20, 2016. As noted earlier, the risk-free rate and the market risk premium on that day were 2.88 percent and 5.92 percent, respectively. Since you have already decided that Domino's Pizza is a reasonably comparable company, you obtain Domino's beta from the Google Finance Web site (http://www.google.com/finance). This beta is 0.60. What do you estimate the cost of common stock in your pizza business to be?

Approach The problem statement provides us with the information necessary to use the Capital Asset Pricing Model (CAPM). Therefore, in this example we will use Equation 13.4.

Solution

$k_{cs} = R_{rf} + (\beta_{cs} \times \text{Market risk premium}) = 0.0288 + (0.60 \times 0.0592) = 0.0643$, or 6.43%

$$k_{cs} = \frac{D_1}{P_0} + g \tag{13.5}$$

Figure 13.13

$$k_{cs} = \frac{D_1}{P_0} + g = \frac{\$2}{\$20} + 0.03 = 0.1300, \text{ or } 13.00\%$$

Figure 13.14

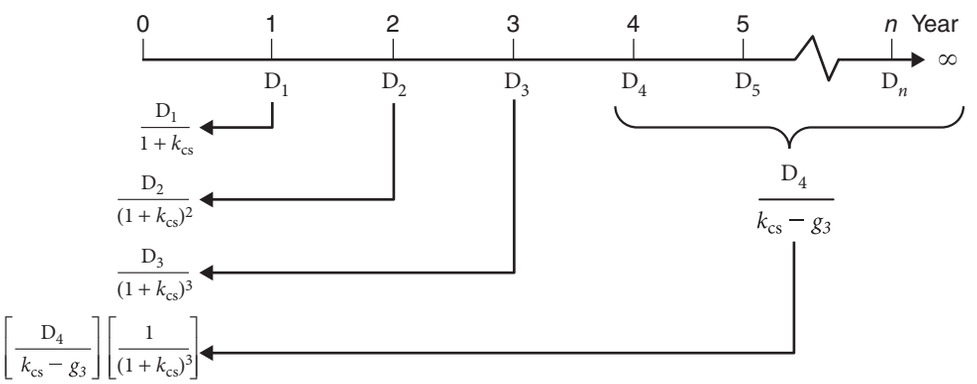
$$P_0 = \frac{D_1}{1+R} + \frac{D_2}{(1+R)^2} + \cdots + \frac{D_t}{(1+R)^t} + \frac{P_t}{(1+R)^t}$$

Figure 13.15

$$P_0 = \frac{D_1}{1+k_{cs}} + \frac{D_1(1+g_1)}{(1+k_{cs})^2} + \frac{D_1(1+g_1)(1+g_2)}{(1+k_{cs})^3} + \left[\frac{D_1(1+g_1)(1+g_2)(1+g_3)}{k_{cs}-g_3}\right]\left[\frac{1}{(1+k_{cs})^3}\right]$$

Figure 13.16

$$P_0 = \frac{D_1}{1 + k_{cs}} + \frac{D_2}{(1 + k_{cs})^2} + \frac{D_3}{(1 + k_{cs})^3} + \left[\frac{D_4}{k_{cs} - g_3}\right]\left[\frac{1}{(1 + k_{cs})^3}\right]$$



$$P_0 = \frac{D_1}{1 + k_{cs}} + \frac{D_2}{(1 + k_{cs})^2} + \frac{D_3}{(1 + k_{cs})^3} + \left[\frac{D_4}{k_{cs} - g_3}\right]\left[\frac{1}{(1 + k_{cs})^3}\right]$$

EXHIBIT 13.2 **The Three-Stage Dividend Growth Equation**

In the three-stage dividend growth equation shown here, the price of a share of stock is equal to the present value of dividends expected to be received at the end of Years 1, 2, and 3, plus the present value of a growing perpetuity that begins in Year 4 and whose dividends are assumed to grow at a constant rate g_3 forever.

Figure 13.17

$$P_0 = \frac{D_1}{1 + k_{cs}} + \frac{D_2}{(1 + k_{cs})^2} + \frac{D_3}{(1 + k_{cs})^3} + \frac{D_4}{(1 + k_{cs})^4} + \left[\frac{D_5}{k_{cs} - g_4}\right]\left[\frac{1}{(1 + k_{cs})^4}\right]$$

Figure 13.18

$$D_1 = \$1.50$$
$$D_2 = D_1 \times (1 + g_1) = \$1.500 \times 1.15 = \$1.725$$
$$D_3 = D_2 \times (1 + g_2) = \$1.725 \times 1.10 = \$1.898$$
$$D_4 = D_3 \times (1 + g_3) = \$1.898 \times 1.07 = \$2.031$$
$$D_5 = D_4 \times (1 + g_4) = \$2.031 \times 1.05 = \$2.133$$

Figure 13.19

$$\$24 = \frac{\$1.50}{1 + k_{cs}} + \frac{\$1.73}{(1 + k_{cs})^2} + \frac{\$1.90}{(1 + k_{cs})^3} + \frac{\$2.03}{(1 + k_{cs})^4} + \left[\frac{\$2.13}{k_{cs} - g_4}\right]\left[\frac{1}{(1 + k_{cs})^4}\right]$$

Using Excel

Solving for k_{cs} Using a Multistage-Growth Dividend Model

Because trial-and-error calculations can be somewhat tedious when you perform them by hand, you may find it helpful to use a spreadsheet program. If you would like to use a spreadsheet program to solve the preceding problem yourself, the output from the spreadsheet below shows you how to do it using trial and error.

Once you input the indicated numbers and formulas into cells B3 through B14, you can then vary the number in cell B2 until the number in cell B8 equals \$24. Once you have built the model, you can also use the "goal seek" or "solver" functions in Excel to avoid having to manually solve the problem by trial and error. See the "Help" feature in Excel for information on how to use these functions.

<>	A	B	C	D
1				Comment
2	k_{cs} =	0.1220		Change this number until the P_0 equals \$24.00
3	g_1 =	0.15		Growth rate in year 1
4	g_2 =	0.10		Growth rate in year 2
5	g_3 =	0.07		Growth rate in year 3
6	g_4 =	0.05		Growth rate for perpetuity
7				
8	P_0 =	\$24.00		Formula: =NPV(B2,B11:B14) - This formula calculates the present value of the
9				future dividends in cells B11 to B14 using the discount rate in cell B2.
10	Year			
11	1	\$1.500		D_1
12	2	\$1.725		D_2 = B11*(1+B3)
13	3	\$1.898		D_3 = B12*(1+B4)
14	4	\$31.619		D_4 = [B13*(1+B5)] + [B13*(1+B5)*(1+B6)]/(B2-B6) - This formula calculates the
15				value of D_4 plus the present value of all the cash flows after year 4 in year 4 dollars.
16				

$$k_{ps} = \frac{D_{ps}}{P_{ps}} \tag{13.6}$$

LEARNING BY DOING

APPLICATION 13.4 | Estimating the Cost of Preferred Stock

Problem You work in the treasury department at Wells Fargo & Company, and your manager has asked you to estimate the cost of each of the different types of stock that Wells Fargo has outstanding. One of these issues is an 8 percent noncumulative preferred stock that has a stated value of $1,000 and is currently selling for $927.90. Although this preferred stock is publicly traded, it does not trade very often. This means that you cannot use the CAPM to estimate k_{ps} because you cannot get a good estimate of the beta using regression analysis. How else can you estimate the cost of this preferred stock, and what is this cost?

Approach You can also use Equation 13.6 to estimate the cost of preferred stock.

Solution First, you must find the annual dividend that someone who owns a share of this stock will receive. This preferred stock issue pays an annual dividend (for simplicity we are assuming one dividend payment per year) that equals 8 percent of $1,000, or $1,000 × 0.8 = $80. Substituting the annual dividend and the market price into Equation 13.6 yields:

$$k_{ps} = \frac{D_{ps}}{P_{ps}} = \frac{\$80}{\$927.90} = 0.0862, \text{ or } 8.62\%$$

$$\text{WACC} = x_{\text{Debt}} k_{\text{Debt pretax}} (1 - t) + x_{ps} k_{ps} + x_{cs} k_{cs} \tag{13.7}$$

Figure 13.20

$$\begin{aligned} k_{\text{Debt pretax}} &= x_{\text{Bank loan 1}} k_{\text{Bank loan 1 pretax}} + x_{\text{Bank loan 2}} k_{\text{Bank loan 2 pretax}} + x_{\text{Bonds}} k_{\text{Bonds pretax}} \\ &= (\$4/\$17)(0.06) + (\$3/\$17)(0.055) + (\$10/\$17)(0.07) \\ &= 0.0650, \text{ or } 6.50\% \end{aligned}$$

Figure 13.21

$$k_{ps} = \frac{D_{ps}}{P_{ps}} = \frac{0.045 \times \$100}{\$60}$$
$$= \frac{\$4.5}{\$60} = 0.0750, \text{ or } 7.50\%$$

Figure 13.22

$$k_{cs} = R_{rf} + (\beta_{cs} \times \text{Market risk premium}) = 0.0288 + (1.1 \times 0.0592)$$
$$= 0.0939, \text{ or } 9.39\%$$

Figure 13.23

$$\text{WACC} = x_{\text{Debt}} k_{\text{Debt pretax}}(1 - t) + x_{ps} k_{ps} + x_{cs} k_{cs}$$
$$= (\$17/\$44)(0.0650)(1 - 0.35) + (\$6/\$44)(0.0750) + (\$21/\$44)(0.0939)$$
$$= 0.0714, \text{ or } 7.14\%$$

LEARNING BY DOING

APPLICATION 13.5 | Calculating the WACC with Equation 13.7

Problem After calculating the cost of the common equity in your pizza business to be 6.43 percent (see Learning by Doing Application 13.3), you have decided to estimate the WACC. You recently hired a business appraiser to estimate the value of your stock, which includes all of the outstanding common equity. His report indicates that it is worth $500 million.

In order to finance the 2,000 restaurants that are now part of your company, you have sold three different bond issues. Based on the current prices of the bonds from these issues and the issue characteristics (face values and coupon rates), you have estimated the market values and effective annual yields to be:

Bond Issue	Value ($ millions)	Effective Annual Yield
1	$100	4.50%
2	187	4.90
3	154	5.40
Total	$441	

Your company has no other long-term debt or any preferred stock outstanding. Both the marginal and average tax rates for your company are 20 percent. What is the WACC for your pizza business?

Approach You can use Equation 13.7 to solve for the WACC for your pizza business. To do so, you must first calculate the weighted average cost of debt. You can then plug the weights and costs for the debt and common equity into Equation 13.7. Since your business has no preferred stock, the value for this term in Equation 13.7 will equal $0.

Solution The weighted average cost of the debt is:

$$\begin{aligned} k_{\text{Debt pretax}} &= x_1 k_{1\text{ Debt pretax}} + x_2 k_{2\text{ Debt pretax}} + x_3 k_{3\text{ Debt pretax}} \\ &= (\$100/\$441)(0.0450) + (\$187/\$441)(0.0490) + (\$154/\$441)(0.0540) \\ &= 0.0498, \text{ or } 4.98\% \end{aligned}$$

and the WACC is:

$$\begin{aligned} \text{WACC} &= x_{\text{Debt}} k_{\text{Debt pretax}}(1 - t) + x_{\text{ps}} k_{\text{ps}} + x_{\text{cs}} k_{\text{cs}} \\ &= (\$441/[\$441 + \$500])(0.0498)(1 - 0.20) + 0 + (\$500/[\$441 + \$500])(0.0643) \\ &= 0.0528, \text{ or } 5.28\% \end{aligned}$$

EXAMPLE 13.2 | Interpreting the WACC

DECISION MAKING

Situation You are a financial analyst for the company whose WACC of 7.14 percent we just calculated in the main text. One day, your manager walks into your office and tells you that she is thinking about selling $23 million of common stock and using the proceeds from the sale to pay back both of the firm's loans and to repurchase all of the outstanding bonds and preferred stock. She tells you that this is a smart move because if she does this, the beta of the firm's common stock will decline to 0.90 and the overall k_{cs} will decline from 9.39 percent to 8.21 percent:

$$\begin{aligned} k_{cs} &= R_{rf} + (\beta_{cs} \times \text{Market risk premium}) = 0.0288 + (0.90 \times 0.0592) \\ &= 0.0821, \text{ or } 8.21\% \end{aligned}$$

What do you tell your manager?

Decision You should politely point out that she is making the wrong comparison. Since the refinancing will result in the firm being financed entirely with equity, k_{cs} will equal the firm's WACC. Therefore, the 8.21 percent should really be compared with the 7.14 percent WACC. If your manager goes through with the refinancing, she will be making a bad decision. The average after-tax cost of the capital that your firm uses will *increase* from 7.14 percent to 8.21 percent.

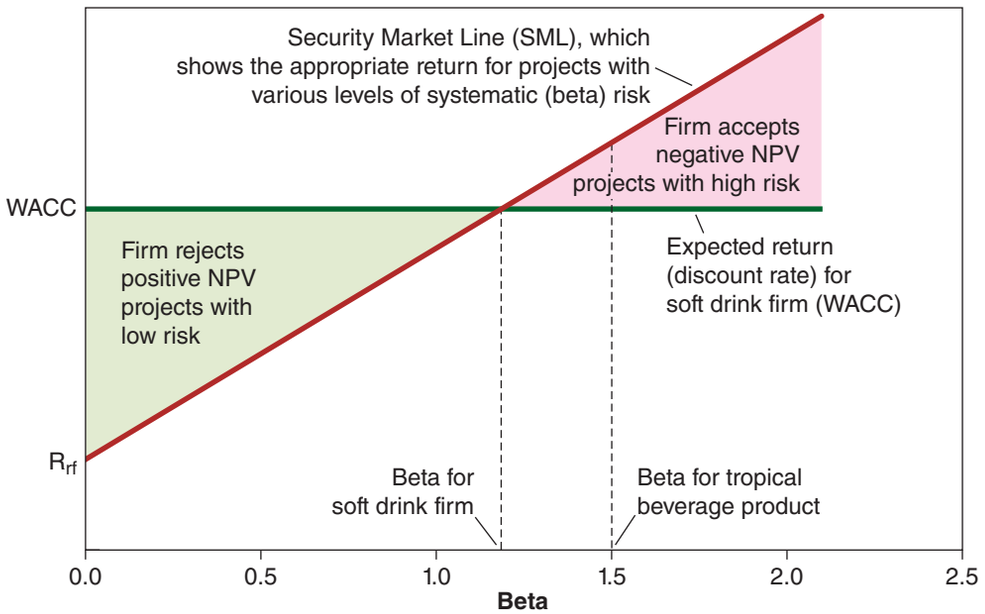


EXHIBIT 13.3 **Potential Errors When Using the WACC to Evaluate Projects**

Two types of problems can arise when the WACC for a firm is used to evaluate individual projects: positive NPV projects may be rejected or negative NPV projects may be accepted. For the tropical beverage example, if the expected return on that project was below the level indicated by the SML, but above the firm's WACC, the project might be accepted even though it would have a negative NPV.

Figure 13.24

$$\begin{aligned} \text{NPV} &= \text{FCF}_0 + \frac{\text{FCF}_1}{1+k} + \frac{\text{FCF}_2}{(1+k)^2} + \frac{\text{FCF}_3}{(1+k)^3} \\ &= -\$100 + \frac{\$40}{1+0.08} + \frac{\$40}{(1+0.08)^2} + \frac{\$40}{(1+0.08)^3} \\ &= \$3.08 \end{aligned}$$

Figure 13.25

$$\text{NPV} = -\$100 + \frac{\$40}{1+0.11} + \frac{\$40}{(1+0.11)^2} + \frac{\$40}{(1+0.11)^3} = -\$2.25$$

Figure 13.26

$$\text{WACC} = x_{\text{Debt}}\, k_{\text{Debt pretax}}(1-t) + x_{\text{ps}}\, k_{\text{ps}} + x_{\text{cs}}\, k_{\text{cs}}$$

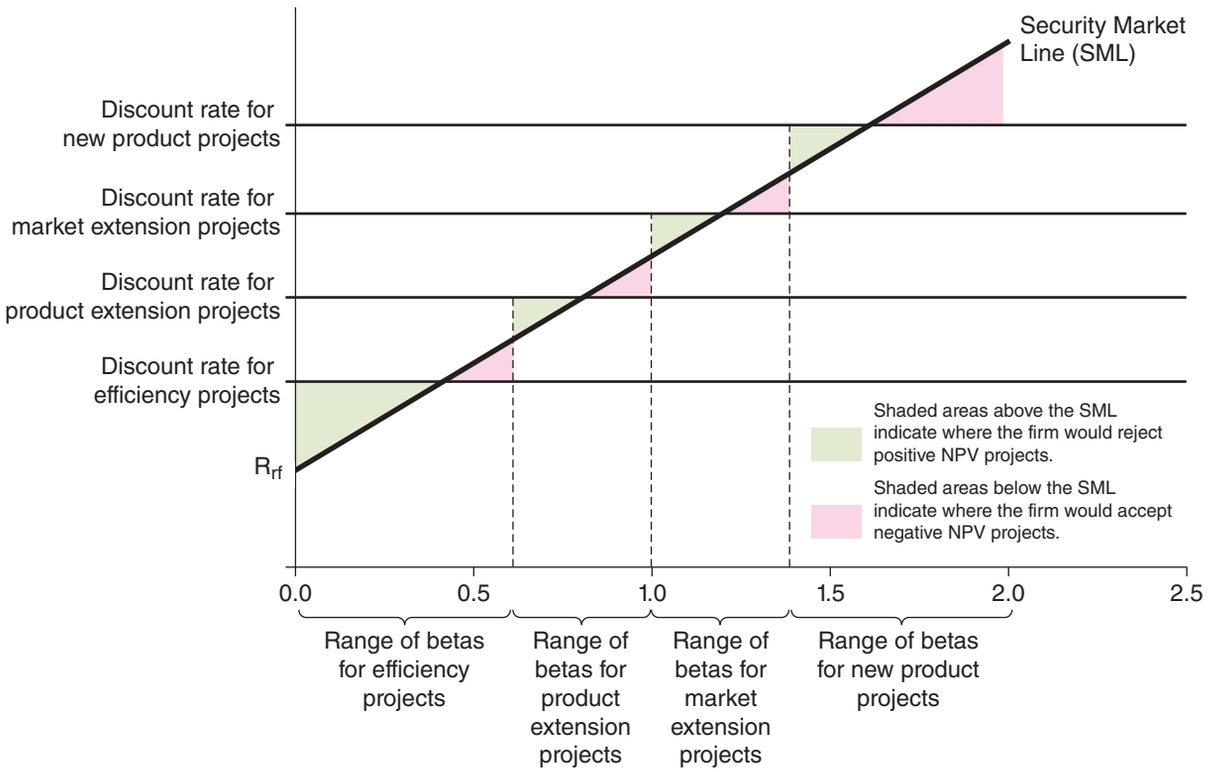


EXHIBIT 13.4 **Potential Errors When Using Multiple Discount Rates to Evaluate Projects**

The potential for errors—either rejecting a positive NPV project or accepting a negative NPV project—is smaller when discount rates better reflect the risk of the projects that they are used to evaluate. You can see this by noting that the total size of the shaded areas in this figure is smaller than the size of the shaded areas in Exhibit 13.3. In the ideal situation, where the correct discount rate is used for each project, there would be no shaded area at all in a figure like this.

Summary of Key Equations

Equation	Description	Formula
13.1	Finance balance sheet identity	MV of assets = MV of liabilities + MV of equity
13.2	General formula for weighted average cost of capital (WACC) for a firm	$k_{\text{Firm}} = \sum_{i=1}^{n} x_i k_i = x_1 k_1 + x_2 k_2 + x_3 k_3 + \cdots + x_n k_n$
13.3	After-tax cost of debt	$k_{\text{Debt after-tax}} = k_{\text{Debt pretax}} \times (1 - t)$
13.4	CAPM formula for the cost of common stock	$k_{cs} = R_{rf} + (\beta_{cs} \times \text{Market risk premium})$
13.5	Constant-growth dividend formula for the cost of common stock	$k_{cs} = \frac{D_1}{P_0} + g$
13.6	Perpetuity formula for the cost of preferred stock	$k_{ps} = \frac{D_{ps}}{P_{ps}}$
13.7	Traditional WACC formula	$\text{WACC} = x_{\text{Debt}} k_{\text{Debt pretax}} (1 - t) + x_{ps} k_{ps} + x_{cs} k_{cs}$

Self-Study Problems

13.1 The market value of a firm's assets is $3 billion. If the market value of the firm's liabilities is $2 billion, what is the market value of the stockholders' investment and why?

13.2 Berron Comics, Inc., has borrowed $100 million and is required to pay its lenders $8 million in interest this year. If Berron is in the 35 percent marginal tax bracket, then what is the after-tax cost of debt (in dollars as well as in annual interest percentage) to Berron?

13.3 Explain why the after-tax cost of equity (common or preferred) does not have to be adjusted by the marginal income tax rate for the firm.

13.4 Mike's T-Shirts, Inc., has debt claims of $400 (market value) and equity claims of $600 (market value). If the after-tax cost of debt financing is 11 percent and the cost of equity is 17 percent, what is Mike's weighted average cost of capital?

13.5 You are analyzing a firm that is financed with 60 percent debt and 40 percent equity. The current cost of debt financing is 10 percent, but due to a recent downgrade by the rating agencies, the firm's cost of debt is expected to increase to 12 percent immediately. How will this increase change the firm's weighted average cost of capital if you ignore taxes? If you consider taxes and the firm is subject to a 40 percent marginal tax rate?

Solutions to Self-Study Problems

13.1 Since the identity that Value of assets = Value of liabilities + Value of equity holds for market values as well as book values, we know that the market value of the firm's equity is $3 billion − $2 billion = $1 billion.

13.2 Because Berron enjoys a tax deduction for its interest charges, the after-tax interest expense for Berron is $8 million × (1 − 0.35) = $5.2 million, which translates into an annual after-tax interest percentage of $5.2/$100 = 0.052, or 5.2 percent.

13.3 The U.S. tax code allows a deduction for interest expense incurred on borrowing. Preferred and common shares are not considered debt and, thus, do not benefit from an interest deduction. As a result, there is no distinction between the before-tax and after-tax cost of equity capital.

13.4 Mike's T-Shirts' total firm value = $400 + $600 = $1,000. Therefore,

Debt = 40% of financing

Equity = 60% of financing

$$\text{WACC} = x_{\text{Debt}}k_{\text{Debt}}(1 - t) + x_{\text{ps}}k_{\text{ps}} + x_{\text{cs}}k_{\text{cs}}$$

$$\text{WACC} = (0.4 \times 0.11) + (0.6 \times 0.17) = 0.146, \text{ or } 14.6\%$$

13.5 The pretax debt contribution to the cost of capital is $x_{\text{Debt}} \times k_{\text{Debt}}$, and since the firm's pretax cost of debt is expected to increase by 2 percent, we know that the effect on WACC (pretax) will be 0.6 × 0.02 = 0.012, or 1.2 percent. If we assume that the firm is subject to the 40 percent marginal tax rate, then the after-tax increase in the cost of capital for the firm would be 0.012 × (1 − 0.4) = 0.0072, or 0.72 percent.

Discussion Questions

13.1 Explain why the required rate of return on a firm's assets must be equal to the weighted average cost of capital associated with its liabilities and equity.

13.2 Which is easier to calculate directly, the expected rate of return on the assets of a firm or the expected rate of return on the firm's debt and equity? Assume that you are an outsider to the firm.

13.3 With respect to the level of risk and the required return for a firm's portfolio of projects, discuss how the market and a firm's management can have inconsistent information and expectations.

13.4 Your friend has recently told you that the federal government effectively subsidizes the use of debt financing (vs. equity financing) for corporations. Do you agree with that statement? Explain.

13.5 Your firm will have a fixed interest expense for the next 10 years. You recently found out that the marginal income tax rate for the firm will change from 30 percent to 40 percent next year. Describe how the change will affect the cash flow available to investors.

13.6 Describe why it is not usually appropriate to use the coupon rate on a firm's bonds to estimate the pretax cost of debt for the firm.

13.7 Maltese Falcone, Inc., has not checked its weighted average cost of capital for four years. Firm management claims that since Maltese has not had to raise capital for new projects in four years, they should not have to worry about their current weighted average cost of capital. They argue that they have essentially locked in their cost of capital. Critique management's statements.

13.8 Ten years ago, the Edson Water Company issued preferred stock at a price equal to the par value of $100. If the dividend yield on that issue was 12 percent, explain why the firm's current cost of preferred capital is not likely to equal 12 percent.

13.9 Discuss under what circumstances you might be able to use a model that assumes constant growth in dividends to calculate the current cost of equity capital for a firm.

13.10 Your boss just finished computing your firm's weighted average cost of capital. He is relieved because he says that he can now use that cost of capital to evaluate all projects that the firm is considering for the next four years. Evaluate that statement.

Questions and Problems

Basic

13.1 **Finance balance sheet:** KneeMan Markup Company has total debt obligations with book and market values equal to $30 million and $28 million, respectively. It also has total equity with book and market values equal to $20 million and $70 million, respectively. If you were going to buy all of the assets of KneeMan Markup today, how much should you be willing to pay?

13.2 **WACC:** What is the weighted average cost of capital for a firm?

13.3 **Taxes and the cost of debt:** How are taxes accounted for when we calculate the cost of debt?

13.4 **Cost of common stock:** List and describe each of the three methods used to calculate the cost of common stock.

13.5 **Cost of common stock:** Whitewall Tire Co. just paid an annual dividend of $1.60 on its common shares. If Whitewall is expected to increase its annual dividend by 2 percent per year into the foreseeable future and the current price of Whitewall's common shares is $11.66, what is the cost of common stock for Whitewall?

13.6 **Cost of common stock:** Seerex Wok Co. is expected to pay a dividend of $1.10 one year from today on its common shares. That dividend is expected to increase by 5 percent every year thereafter. If the price of Seerex common stock is $13.75, what is the cost of its common equity capital?

13.7 **Cost of common stock:** Two-Stage Rocket paid an annual dividend of $1.25 yesterday, and it is commonly known that the firm's management expects to increase its dividend by 8 percent for the next two years and by 2 percent thereafter. If the current price of Two-Stage's common stock is $17.80, what is the cost of common equity capital for the firm?

13.8 **Cost of preferred stock:** Fjord Luxury Liners has preferred shares outstanding that pay an annual dividend equal to $15 per year. If the current price of Fjord preferred shares is $107.14, what is the after-tax cost of preferred stock for Fjord?

13.9 **Cost of preferred stock:** Kresler Autos has preferred shares outstanding that pay annual dividends of $12, and the current price of the shares is $80. What is the after-tax cost of new preferred shares for Kresler if the flotation (issuance) costs for preferred shares are 5 percent?

13.10 **WACC:** Describe the alternatives to using a firm's WACC as a discount rate when evaluating a project.

13.11 **WACC:** Capital Co. has a capital structure, based on current market values, that consists of 50 percent debt, 10 percent preferred stock, and 40 percent common stock. If the returns required by investors are 8 percent, 10 percent, and 15 percent for the debt, preferred stock, and common stock, respectively, what is Capital's after-tax WACC? Assume that the firm's marginal tax rate is 40 percent.

13.12 **WACC:** What are direct out-of-pocket costs?

Intermediate

13.13 **Finance balance sheet:** Explain why the total value of all of the securities used to finance a firm must be equal to the value of the firm.

13.14 **Finance balance sheet:** Explain why the cost of capital for a firm is equal to the expected rate of return to the investors in the firm.

13.15 **Current cost of a bond:** You know that the after-tax cost of debt capital for Bubbles Champagne Company is 7 percent. If the firm has only one issue of five-year bonds outstanding, what is the current price of the bonds if the coupon rate on those bonds is 10 percent? Assume the bonds make semiannual coupon payments and the marginal tax rate is 30 percent.

13.16 **Current cost of a bond:** Perpetual Ltd. has issued bonds that never require the principal amount to be repaid to investors. Correspondingly, Perpetual must make interest payments into the infinite future. If the bondholders receive annual payments of $75 and the current price of the bonds is $882.35, what is the after-tax cost of this debt for Perpetual if the firm is subject to a 40 percent marginal tax rate?

13.17 **Current cost of a bond:** You are analyzing the cost of debt for a firm. You know that the firm's 14-year maturity, 8.5 percent coupon bonds are selling at a price of $823.48. The bonds pay interest semiannually. If these bonds are the only debt outstanding, what is the after-tax cost of debt for this firm if it is subject to 30 percent marginal and average tax rates?

13.18 **Taxes and the cost of debt:** Holding all other things constant, does a decrease in the marginal tax rate for a firm provide incentive for the managers of a firm to increase or decrease its use of debt?

13.19 **Cost of debt for a firm:** You are analyzing the after-tax cost of debt for a firm. You know that the firm's 12-year maturity, 9.5 percent semiannual coupon bonds are selling at a price

of $1,200. If these bonds are the only debt outstanding for the firm, what is the after-tax cost of debt for this firm if it has a marginal tax rate of 34 percent? What if the bonds are selling at par?

13.20 **Cost of common stock:** Underestimated Inc.'s common shares currently sell for $36 each. The firm's management believes that its shares should really sell for $54 each. If the firm just paid an annual dividend of $2 per share and management expects those dividends to increase by 8 percent per year forever (and this is common knowledge to the market), what is the current cost of common equity for the firm and what does management believe is the correct cost of common equity for the firm?

13.21 **Cost of common stock:** Write out the general equation for the price of the stock for a firm that will grow dividends very rapidly at a constant rate for the four years after the next dividend is paid and will grow dividends thereafter at a constant, but lower rate. Discuss the problems in estimating the cost of equity capital for such a stock.

13.22 **Cost of common stock:** You have calculated the cost of common stock using all three methods described in this chapter. Unfortunately, all three methods have yielded different answers. Describe which answer (if any) is most appropriate.

13.23 **WACC:** The managers of a firm financed entirely with common stock are evaluating two distinct projects. The first project has a large amount of unsystematic risk and a small amount of systematic risk. The second project has a small amount of unsystematic risk and a large amount of systematic risk. Which project, if taken, is more likely to increase the firm's cost of capital?

13.24 **WACC:** The Imaginary Products Co. currently has debt with a market value of $300 million outstanding. The debt consists of 9 percent coupon bonds (semiannual coupon payments) that have a maturity of 15 years and are currently priced at $1,440.03 per bond. The firm also has an issue of 2 million preferred shares outstanding with a market price of $12.00 per share. The preferred shares pay an annual dividend of $1.20. Imaginary also has 14 million shares of common stock outstanding with a price of $20.00 per share. The firm is expected to pay a $2.20 common dividend one year from today, and that dividend is expected to increase by 5 percent per year forever. If Imaginary is subject to a 40 percent marginal tax rate, then what is the firm's weighted average cost of capital?

13.25 **Choosing a discount rate:** For the Imaginary Products firm in Problem 13.24, calculate the appropriate cost of capital for a new project that is financed with the same proportion of debt, preferred shares, and common shares as the firm's current capital structure. Also assume that the project has the same degree of systematic risk as the average project that the firm is currently undertaking (the project is also in the same general industry as the firm's current line of business).

13.26 **Choosing a discount rate:** If a firm's management anticipates financing a project with a capital mix that is different from its current capital structure, describe how the firm is subjecting itself to a calculation error if its historical WACC is used to evaluate the project.

Advanced

13.27 You are analyzing the cost of capital for MacroSwift Corporation, which develops software operating systems for computers. The firm's dividend growth rate has been a very constant 3 percent per year for the past 15 years. Competition for the firm's current products is expected to develop in the next year, and MacroSwift is currently expanding its revenue stream into the multimedia industry. Evaluate the appropriateness of continuing to use a 3 percent growth rate in dividends for MacroSwift in your cost of capital model.

13.28 You are an external financial analyst evaluating the merits of a stock. Since you are using a dividend discount model approach to evaluate a cost of equity capital, you need to estimate the dividend growth rate for the firm in the future. Describe how you might go about doing this.

13.29 You know that the return of Momentum Cyclicals common shares is 1.6 times as sensitive to macroeconomic information as the return of the market. If the risk-free rate of return is 2.88 percent and market risk premium is 5.92 percent, what is Momentum Cyclicals' cost of common equity capital?

13.30 In your analysis of the cost of capital for a common stock, you calculate a cost of capital using a dividend discount model that is much lower than the calculation for the cost of capital using the CAPM model. Explain a possible source for the discrepancy.

13.31 RetRyder Hand Trucks has a preferred share issue outstanding that pays a dividend of $1.30 per year. The current cost of preferred equity for RetRyder is 9 percent. If RetRyder issues additional preferred shares that pay exactly the same dividend and the investment banker retains 8 percent of the sale price, what is the cost of the new preferred shares for RetRyder?

13.32 Enigma Corporation's management believes that the firm's cost of capital (WACC) is too high because the firm has been too secretive with the market concerning its operations. Evaluate that statement.

13.33 Discuss what valuable information would be lost if you decided to use book values in order to calculate the cost of each of the capital components within a firm's capital structure.

13.34 Hurricane Corporation is financed with debt, preferred equity, and common equity with market values of $20 million, $10 million, and $30 million, respectively. The betas for the debt, preferred stock, and common stock are 0.2, 0.5, and 1.1, respectively. If the risk-free rate is 2.88 percent, the market risk premium is 5.92 percent, and Hurricane's average and marginal tax rates are both 30 percent, what is the company's weighted average cost of capital?

13.35 You are working as an intern at Coral Gables Products, a privately owned manufacturing company. Shortly after you read Chapter 13 in this book, you got into a discussion with the chief financial officer (CFO) at Coral Gables about weighted average cost of capital calculations. She pointed out that, just as the beta of the assets of a firm equals a weighted average of the betas for the individual assets, as shown in Equation 7.13:

$$\beta_{n\ \text{Asset portfolio}} = \sum_{i=1}^{n} x_i\beta_i = x_1\beta_1 + x_2\beta_2 + x_3\beta_3 + \cdots + x_n\beta_n$$

the beta of the assets of a firm also equals a weighted average of the betas for the debt, preferred stock, and common stock of a firm:

$$\beta_{n\ \text{Asset portfolio}} = \sum_{i=1}^{n} x_i\beta_i = x_{\text{Debt}}\beta_{\text{Debt}} + x_{\text{ps}}\beta_{\text{ps}} + x_{\text{cs}}\beta_{\text{cs}}$$

Why must this be true?

13.36 The CFO described in Problem 13.35 asks you to estimate the beta for Coral Gables' common stock. Since the common stock is not publicly traded, you do not have the data necessary to estimate the beta

using regression analysis. However, you have found a company with publicly traded stock that has operations exactly like those at Coral Gables. Using stock returns for this pure-play comparable fi rm, you estimate the beta for the comparable company's stock to be 1.06. The market value of that company's common equity is $45 million, and it has one debt issue outstanding with a market value of $15 million and an annual pretax cost of 4.85 percent. The comparable company has no preferred stock.

a. If the risk-free rate is 2.88 percent and the market risk premium is 5.92 percent, what is the beta of the assets of the comparable company?

b. If the total market value of Coral Gables' financing consists of 35 percent debt and 65 percent equity (this is what the CFO estimates the market values to be) and the pretax cost of its debt is 5.45 percent, what is the beta for Coral Gables' common stock?

13.37 Estimate the weighted average cost of capital for Coral Gables using your estimated beta and the information in the problem statement in Problem 13.36. Assume that the average and marginal tax rates for Coral Gables are both 25 percent.

CFA Problems

13.38 The cost of equity is equal to the:

a. Expected market return.

b. Rate of return required by stockholders.

c. Cost of retained earnings plus dividends.

d. Risk the company incurs when financing.

13.39 Dot.Com has determined that it could issue $1,000 face value bonds with an 8 percent coupon paid semiannually and a five-year maturity at $900 per bond. If Dot.Com's marginal tax rate is 38 percent, its after-tax cost of debt is closest to:

a. 6.2 percent. **c.** 6.6 percent.

b. 6.4 percent. **d.** 6.8 percent.

13.40 Morgan Insurance Ltd. issued a fixed-rate perpetual preferred stock three years ago and placed it privately with institutional investors. The stock was issued at $25.00 per share with a $1.75 dividend. If the company were to issue preferred stock today, the yield would be 6.5 percent. The stock's current value is:

a. $25.00. **c.** $37.31.

b. $26.92. **d.** $40.18.

13.41 The Gearing Company has an after-tax cost of debt capital of 4 percent, a cost of preferred stock of 8 percent, a cost of equity capital of 10 percent, and a weighted average cost of capital of 7 percent. Gearing intends to maintain its current capital structure as it raises additional capital. In making its capital-budgeting decisions for the average-risk project, the relevant cost of capital is:

a. 4 percent. **c.** 8 percent.

b. 7 percent. **d.** 10 percent.

13.42 Suppose the cost of capital of the Gadget Company is 10 percent. If Gadget has a capital structure that is 50 percent debt and 50 percent equity, its before-tax cost of debt is 5 percent, and its marginal tax rate is 20 percent, then its cost of equity capital is closest to:

a. 10 percent. **c.** 14 percent.

b. 12 percent. **d.** 16 percent.

Sample Test Problems

13.1 Howard Power and Telecommunications Corporation has three divisions. The names of these divisions, along with the after-tax cost of capital for each division and the market value of the assets in each division, are as follows:

Division Name	Cost of Capital	MV of Assets
Infrastructure development	8.75	$250,000,000
Power	7.50	$325,000,000
Telecommunications	8.25	$675,000,000

What is the overall after-tax cost of capital for Howard Power and Telecommunications?

13.2 Quarri Industries has 8 percent coupon bonds outstanding. These bonds have a market price of $954.41, pay interest semiannually, and will mature in six years. If the tax rate is 35 percent, what are the pretax cost and after-tax cost of this debt?

13.3 Quarri Industries common stock has a beta of 1.6. If the market risk-free rate is 4 percent and the expected return on the market is 9 percent, what is Quarri's cost of common stock?

13.4 Miron's Copper Corp. management expects its common stock dividends to grow 1.5 percent per year for the indefinite future. The firm's shares are currently selling for $18.45, and the firm just paid a dividend of $3.00 yesterday. What is the cost of common stock for Miron?

13.5 Use the information in Questions 13.2 and 13.3 as well as the following information to compute the WACC for Quarri Industries. In addition to common stock, Quarri has 500,000 preferred shares outstanding that pay a quarterly dividend of $0.50 per share and are currently trading for $20.00 a share. The company's outstanding bonds have a face value of $209,553,546. There are 2 million shares of common stock outstanding with a current market price of $98.00 per share.

13.6 Staunton Energy Corporation managers are considering a capital budgeting project to replace some machinery used in one of the company's oil refineries. Is the company's WACC the appropriate discount rate to use in the NPV analysis of this project? Explain.

EXHIBIT 14.1 **Apple Inc. Financial Statements, Fiscal Year Ended September 24, 2016 ($ millions)**

This exhibit shows the balance sheet and income statement for Apple Inc. for the fiscal year ended September 24, 2016. We use this information in illustrating various elements of working capital management.

Balance Sheet as of September 24, 2016

Assets		Liabilities and equity	
Cash	$ 20,484	Accounts payable	$ 37,294
Short-term investments	46,671	Deferred revenue	8,080
Accounts receivable	15,754	Accrued expenses	22,027
Inventory	2,132	Other current liabilites	11,605
Other current assets	21,828	Total current liabilities	$ 79,006
Total current assets	$106,869	Long-term debt	75,427
Property, plant, and equipment	61,245	Other noncurrent liabilities	39,004
Less: Accum. depreciation	34,235	Total liabilities	$193,437
Net plant and equipment	27,010	Preferred stock	0
Investments	170,430	Common stock	31,251
Other noncurrent assets	17,377	Retained earnings	96,364
Total Assets	$321,686	Other stockholder equity	634
		Less: Treasury stock	0
		Total common equity	$128,249
		Total liabilities and stockholder's equity	$321,686

Income Statement for the fiscal year ended September 24, 2016

Net sales	$215,639
Cost of goods sold	131,376
Operating expenses	24,239
Earnings before interest and taxes (EBIT)	$ 60,024
Interest and other income	1,348
Earnings before taxes (EBT)	$ 61,372
Taxes	15,685
Net income	$ 45,687
Common stock dividend	$ 12,188
Stock repurchases	29,000
Addition to retained earnings	$ 4,080

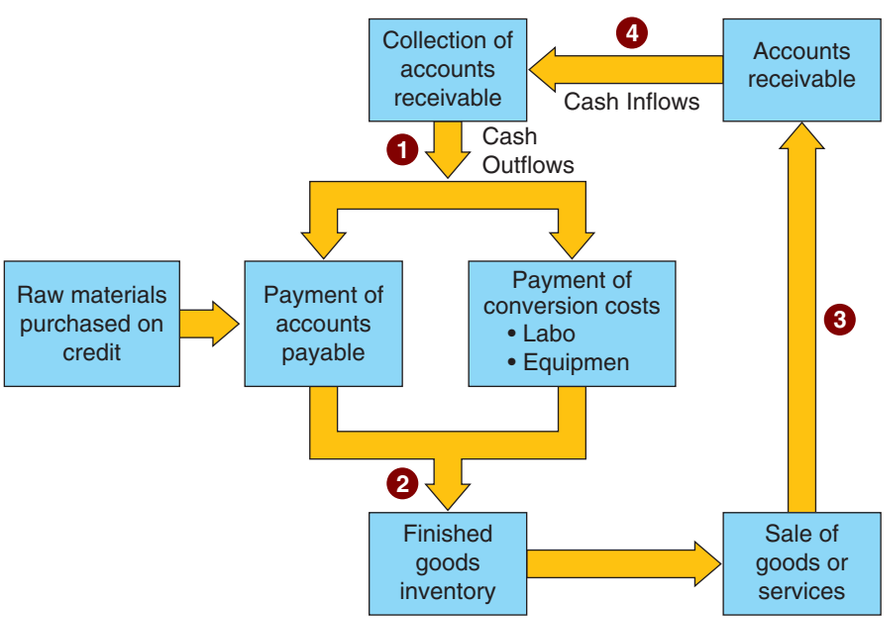


EXHIBIT 14.2 **The Cash Conversion Cycle**

A typical cash conversion cycle begins with cash outflows for raw materials and conversion costs and goes through several stages before these resources are turned back into cash. The cash conversion cycle reflects the average time from the point that cash is used to pay for raw materials until cash is collected on the accounts receivable associated with the product produced with those raw materials. One of the main goals of a financial manager is to optimize the time between the cash outflows and the cash inflows.

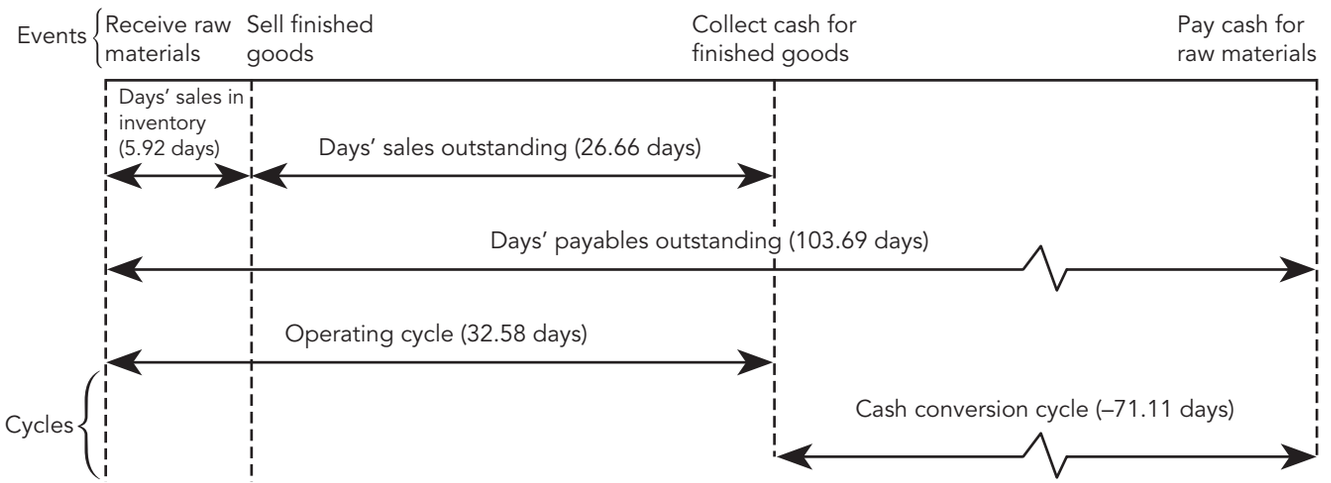


EXHIBIT 14.3 **Time Line for Operating and Cash Conversion Cycles for Apple Inc. in 2016**

The exhibit shows the cash inflows and outflows and other key events in a firm's operating cycle and cash conversion cycle, along with computed values for Apple. Both of these cycles are used for measuring working capital efficiency.

EXHIBIT 14.4 **Selected Financial Ratios for Apple Inc. and the Computer Industry in 2016**

When we compare working capital ratios for Apple with average ratios for the computer industry, we see that Apple is outperforming its peers on all metrics. Apple holds less inventory, collects on its outstanding balances more quickly than competitors, and is able to defer its cash payments to suppliers longer than competitors. These three facts combined ensure that Apple's operating and cash conversion cycles are significantly shorter than is the norm in the computer industry. Note that a negative cash conversion cycle of −71.11 days means that Apple collects cash from its customers before it has to pay its suppliers. Thus, Apple's suppliers are financing all of Apple's working capital and then some.

Financial Ratio	Apple	Computer Industry
Days' sales in inventory (DSI)	5.92	54.25
Days' sales outstanding (DSO)	26.66	58.10
Days' payables outstanding (DPO)	103.69	72.41
Operating cycle (days)	32.58	112.35
Cash conversion cycle (days)	−71.11	39.93

$$\text{Operating cycle} = \text{DSI} + \text{DSO} \qquad (14.1)$$

$$\text{Cash conversion cycle} = \text{DSI} + \text{DSO} - \text{DPO} \quad (14.2)$$
$$= 5.92 \text{ days} + 26.66 \text{ days} - 103.69 \text{ days}$$
$$= -71.11 \text{ days}$$

$$\text{Cash conversion cycle} = \text{Operating cycle} - \text{DPO} \quad (14.3)$$

EXHIBIT 14.5 **Kernel Mills Financial Statements, Fiscal Year Ended December 31, 2017 ($ millions)**

The exhibit shows the balance sheet and income statement for Kernel Mills for the fiscal year ended December 31, 2017, as well as some ratios from the food industry. Use the data to work through and support your analysis in Learning by Doing Application 14.1.

Balance Sheet as of December 31, 2017				Income Statement	
Assets		**Liabilities and equity**			
Cash	$ 175,000	Accounts payable	$ 550,000	Net sales	$5,200,000
Short-term investments	165,000	Notes payable	400,000	Cost of goods sold	3,325,000
Accounts receivable	690,000	Accrued expenses	85,000	Operating expenses	1,500,000
Inventory	660,000	Taxes payable	80,000	Earnings before interest	
Total current assets	$1,690,000	Total current liabilities	$1,115,000	and taxes (EBIT)	$ 375,000
Plant and equipment	2,400,000	Long-term debt	1,100,000	Investment and other income	40,000
Less: Accum. depreciation	(800,000)	Total liabilities	$2,215,000	Interest expense	116,500
Net plant and equipment	1,600,000	Common stock	600,000	Earnings before taxes (EBT)	$ 298,500
Investments	210,000	Retained earnings	685,000	Taxes	148,000
Total assets	$3,500,000	Total common equity	$1,285,000	Net income	$ 150,500
		Total liabilities and stockholder's equity	$3,500,000	Common stock dividend	$ 15,500
				Addition to retained earnings	$ 135,000

Selected food industry ratios: Days' sales in inventory = 71.59, Days' sales outstanding = 44.77, Days' payables outstanding = 58.33, Cash conversion cycle = 58.03 days

LEARNING BY DOING

APPLICATION 14.1 | Measuring Kernel Mills's Working Capital Efficiency

Problem Kernel Mills is a manufacturing firm in the food industry. The board of directors would like to know how efficiently the firm's working capital is being managed. They are particularly interested in the cash conversion cycle. Exhibit 14.5 shows the financial statements for Kernel Mills, as well as some data from the food industry for comparison.

Approach Calculating the cash conversion cycle will answer the directors' question. This will require first calculating the days' sales in inventory (DSI), days' sales outstanding (DSO), and days' payables outstanding (DPO).

Solution

$$\text{DSI} = \frac{365 \text{ days}}{\$3{,}325{,}000/\$660{,}000} = 72.45 \text{ days}$$

It takes Kernel Mills more than 72 days to transform the raw material into finished goods and sell them, which is slightly higher than the industry average of 71.59 days.

$$\text{DSO} = \frac{365 \text{ days}}{\$5{,}200{,}000/\$690{,}000} = 48.43 \text{ days}$$

It takes Kernel Mills more than 48 days to collect cash from its customers. The industry average is 44.77. Kernel Mills could stand to improve the collection time of its accounts receivable.

$$\text{DPO} = \frac{365 \text{ days}}{\$3{,}325{,}000/\$550{,}000} = 60.38 \text{ days}$$

Kernel Mills does not pay cash to its suppliers for more than 60 days. The industry average is a little lower at 58.33.

Kernel Mills's cash conversion cycle for 2017 is $72.45 + 48.43 - 60.38 = 60.50$ days. Thus, about two months pass between the time Kernel Mills pays for its raw materials (cash outflow) and the time it collects cash for the sales of finished goods (cash inflow). In other words, Kernel Mills has to finance its operations for over two months. Although this may seem like a long time, compared with the food industry's average cash conversion cycle of 58.03 days, Kernel Mills is not doing very badly in this area. Two to three days is a small difference.

DECISION MAKING

EXAMPLE 14.1 | Managing Working Capital

Situation You are the CFO of Cornet Construction Supply Company, a wholesale building supplies retailer in the United States Pacific Northwest. Cornet caters to a wide range of customers, from professional building and remodeling contractors to weekend do-it-yourself homeowners. A financial analyst for the firm has reported the following data for the working capital position of Cornet and the average working capital position of competing firms as of the end of fiscal year 2017.

	Cornet Construction Supply	Industry Average
DSI	58 days	75 days
DSO	30 days	45 days
DPO	25 days	30 days

During the last year, Cornet realized sales growth of only 1.5 percent while the average annual sales growth rate for other firms in the industry was 4.8 percent. Given Cornet's relatively weak growth rate, you decide to do everything possible to improve the company's return on assets. As part of this effort, you ask a team of financial analysts for options on how to improve the efficiency with which net working capital is used at Cornet.

Your team recommends the following three actions:

i. Reduce inventory to 50 DSI
ii. Reduce receivables to 25 DSO
iii. Increase payables to 30 DPO

Which, if any, of these recommendations would you choose and why?

Decision All the recommendations will reduce the net working capital needs of Cornet. However, it is possible that more restrictive working capital management policies will do more harm than good. Cornet's average cash conversion cycle of 63 days (58 days + 30 days − 25 days = 63 days) is much less than the 90-day average conversion cycle for the industry. Cornet is already pursuing a relatively restrictive current asset management strategy.

The first two recommendations should probably not be pursued because the operating shortage costs associated with a more restrictive current asset strategy can outweigh the benefits. Cornet maintains a restrictive inventory policy relative to its competitors, and since retail customers rely on in-stock inventory, further tightening might lead to deterioration in sales if it results in stock-outs that drive customers away. With a DSO of 30 days, it appears that Cornet is requiring customers to pay for purchases in 30 days. The industry average is a more lax 45 days for customer receivables. If Cornet tightens its credit policies, it might lose sales as customers switch to other firms that provide longer credit. In fact, it is possible that the lagging sales growth for the firm is a by-product of its restrictive credit terms.

The third recommendation makes the most sense for Cornet. Its current DPO is less than both the industry average and the typical 30 days of credit provided by trade creditors. Increasing DPO to 30 will reduce the cash conversion cycle to 58 days and help improve return on assets.

$$\text{EAR for accounts receivable} = \text{EARR} = \left(1 + \frac{\text{Discount}}{\text{Discounted price}}\right)^{365/\text{days credit}} - 1 \quad (14.4)$$

$$= (1 + 3/97)^{365/30} - 1$$
$$= (1.0309)^{12.1667} - 1$$
$$= 1.4486 - 1$$
$$= 0.4486, \text{ or } 44.86\%$$

LEARNING BY DOING

APPLICATION 14.2 | Cost of Trade Credit

Problem Suppose that a firm sells its goods with terms of 4/10 EOM, net 30. What is the implicit cost of the trade credit?

Approach The terms of sale say that the buyer will receive a 4 percent discount if the full amount is paid in cash within 10 days of the end of the month; otherwise, the buyer must pay the full amount in 20 days. Once we have determined the cost of credit for 20 days, we can use Equation 14.4 to find the annualized rate.

Solution The cost of the credit for 20 days is 4/96 = 4.17 percent.

$$\begin{aligned}\text{EARR} &= \left(1 + \frac{\text{Discount}}{\text{Discounted price}}\right)^{365/\text{days credit}} - 1 \\ &= (1 + 4/96)^{365/20} - 1 \\ &= (1.0417)^{18.2500} - 1 \\ &= 2.10064 - 1 \\ &= 1.10064, \text{ or } 110.064\%\end{aligned}$$

That is pretty expensive credit when annualized!

EXHIBIT 14.6 **Aging Schedule of Accounts Receivable**

An aging schedule shows the breakdown of a firm's accounts receivable by their date of sale; it tells managers how long the accounts have gone unpaid. This exhibit shows the aging schedules for three different firms: Minnow, which is extremely effective in collecting on its accounts receivable, and Rooney and Hastings, which are not performing as well.

	Minnow Corporation		Rooney, Inc.		Hastings Corporation	
Age of Account (days)	Value of Account	% of Total Value	Value of Account	% of Total Value	Value of Account	% of Total Value
0–10	$436,043	60%	$363,370	50%	$319,765	44%
11–30	290,696	40	218,022	30	181,685	25
31–45	0	0	109,011	15	116,278	16
46–60	0	0	36,336	5	72,674	10
Over 60	0	0	0	0	36,337	5
Total	$726,739	100%	$726,739	100%	$726,739	100%

$$\text{EOQ} = \sqrt{\frac{2 \times \text{Reorder costs} \times \text{Sales per period}}{\text{Carrying costs}}} \qquad (14.5)$$

APPLICATION 14.3 | Economic Order Quantity

LEARNING BY DOING

Problem Gator Marine and Supply, one of the largest boat dealers in the South, sells about 1,500 pontoon boats a year. The cost of placing an order with its supplier is $500, the inventory carrying costs are $100 for each boat, and the safety stock is 20 boats. As you would expect, boat sales are very seasonal; thus, all of Gator's sales are made during a four-month period (summer and early fall). What should the average inventory be in boating season? How many orders should the firm place this year?

Approach The key to this problem is to recognize that it is an application of the EOQ formula and that the sales period is four months and not one year. Recognizing these facts, we can apply Equation 14.5 to solve for EOQ:

Solution

$$\text{EOQ} = \sqrt{\frac{2 \times \$500 \times 1{,}500}{\$100}} = 122.47, \text{ or } 123 \text{ boats per order}$$

Gator should order 123 boats per order, and over the four-month boating season, the firm should place 12 orders (1,500 boats per season/123 boats per order = 12.20 orders per season). The average inventory will then be 81.5 boats [(123 boats − 0 boats)/2 + 20 boats in safety stock = 81.5 boats] during the boating season.

APPLICATION 14.4 | When Is a Lockbox Worth Keeping?

LEARNING BY DOING

Problem Simon Electronics is evaluating whether a lockbox it is currently using is worth keeping. Management acknowledges that the lockbox reduces the mail float by 1.5 days and processing time by half a day. The remittances average $100,000 a day for Simon Electronics, with the average check being $1,000. The bank charges $0.30 per processed check. Assume that there are 270 business days in a year and that it costs Simon 5 percent to finance accounts receivable. Should Simon Electronics keep the lockbox?

Approach To solve this problem, we first calculate how much Simon is paying the bank per year to manage the lockbox. Then we can calculate the savings the lockbox provides to Simon by reducing the processing and mail floats.

Solution The average number of checks processed per day is:

$$\text{Average daily remittance/Average check size} = \frac{\$100{,}000}{\$1{,}000} = 100$$

Thus, the cost of a lockbox is:

$$100 \text{ checks} \times \$0.30 \text{ per check} \times 270 \text{ days} = \$8{,}100$$

Next we calculate the savings the lockbox provides:

$$\$100{,}000/\text{day} \times (1.5 \text{ day} + 0.5 \text{ day}) \times 0.05 = \$10{,}000$$

The annual savings are therefore $10,000, which is more than the $8,100 cost of the lockbox. Simon should keep the lockbox.

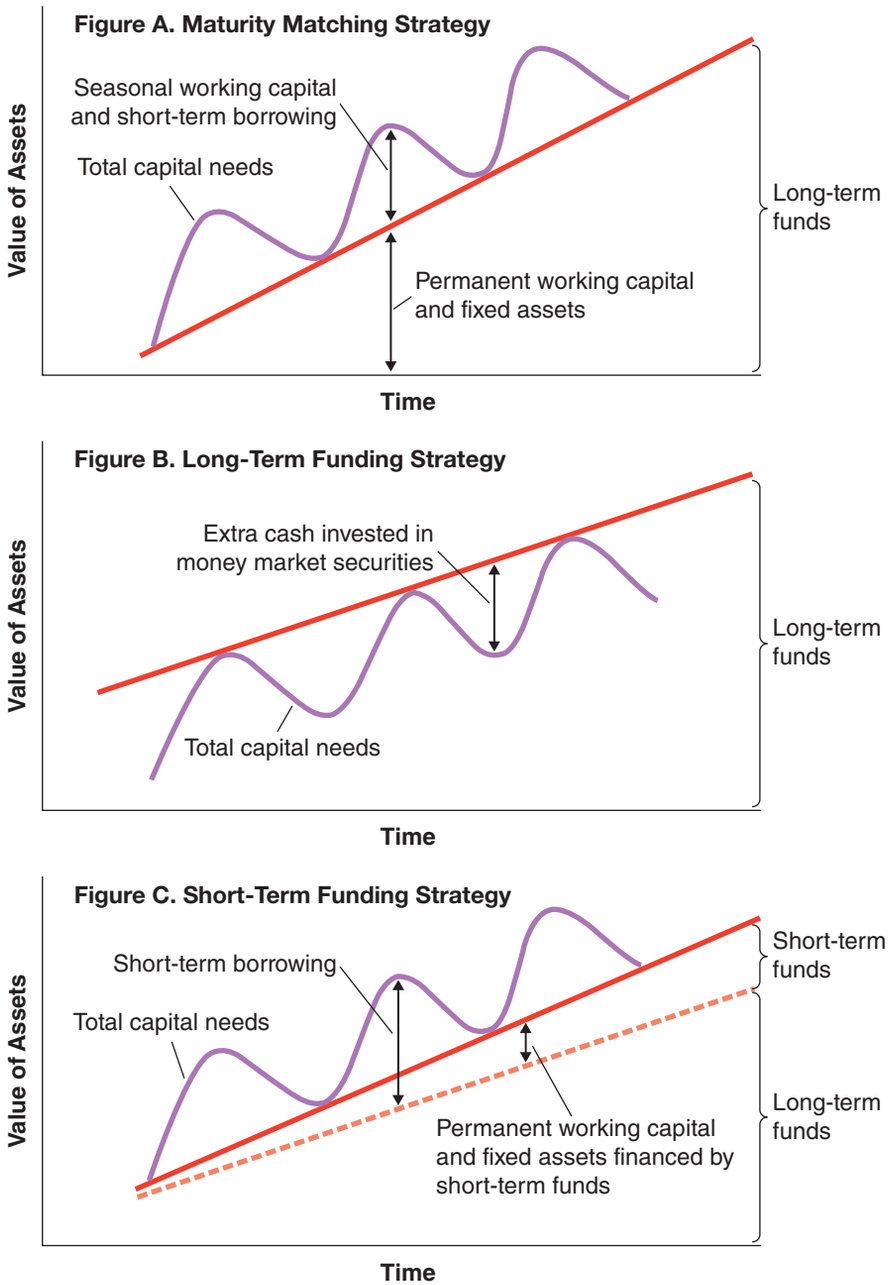


EXHIBIT 14.7 **Working Capital Financing Strategies**

Three alternative strategies for financing working capital and fixed assets are (1) a maturity matching strategy, which matches the maturities of assets and the sources of funding; (2) a long-term funding strategy, which relies on long-term debt to finance both working capital and fixed assets; and (3) a short-term funding strategy, which uses short-term debt to finance all seasonal working capital needs and a portion of permanent working capital and fixed assets.

APPLICATION 14.5 | Effective Annual Interest Rate for Financing from a Factor

LEARNING BY DOING

Problem Kirby Manufacturing sells $100,000 of its accounts receivable to a factor at a 5 percent discount. The firm's average collection period is one month. What is the simple annual cost of the financing provided by the factor, and what is the effective annual loan-equivalent cost?

Approach We must first compute the cost on a per-dollar basis, which will enable us to compute the monthly cost in percentage terms. The key to solving the problem, however, is to realize that we must then calculate the EAR by using Equation 6.7, in order to account for the effect of compounding and therefore the true economic cost.

Solution The discount is 5 percent, and the average collection period is one month. Therefore, in one month, the factor should be able to collect one dollar for every 95 cents paid today. The dollar cost to the company of receiving cash one month earlier is 5 cents ($1 × 0.05 = $0.05), and the amount received is 95 cents ($1 × 0.95 = $0.95). Thus, the monthly cost is $0.05/$0.95 = 0.0526, or 5.26 percent. Plugging the appropriate values into Equation 6.7 and solving for the EAR yields:

$$\text{EAR} = \left(1 + \frac{\text{Quoted interest rate}}{m}\right)^{m} - 1$$
$$= (1 + 0.0526)^{12} - 1 = (1.0526)^{12} - 1 = 0.8500, \text{ or } 85.00\%$$

The annualized cost of the financing from the factor is 85.00 percent.

Summary of Key Equations

Equation	Description	Formula
14.1	Operating cycle	Operating cycle = DSI + DSO
14.2	Cash conversion cycle	Cash conversion cycle = DSI + DSO − DPO
14.3	Cash conversion cycle	Cash conversion cycle = Operating cycle − DPO
14.4	Effective annual rate (EAR) for accounts receivable	$\text{EARR} = \left(1 + \frac{\text{Discount}}{\text{Discounted price}}\right)^{\frac{365}{\text{days credit}}} - 1$
14.5	Economic order quantity (EOQ)	$\text{EOQ} = \sqrt{\frac{2 \times \text{Reorder costs} \times \text{Sales per period}}{\text{Carrying costs}}}$

Self-Study Problems

14.1 You are provided the following working capital information for the Blue Ridge Company for the most recent fiscal year:

Account	Beginning Balance	Ending Balance
Inventory	$ 2,600	$2,890
Accounts receivable	$ 3,222	$2,800
Accounts payable	$ 2,500	$2,670
Net sales	$24,589	
Cost of goods sold	$19,630	

What are the firm's operating and cash conversion cycles?

14.2 Merrifield Cosmetics management calculates that their firm's operating cycle for last year was 76 days. The company had $230,000 in its accounts receivable account and sales of $1.92 million. Approximately how many days does it take from the time raw materials are received at Merrifield until the finished products they are used to produce are sold?

14.3 Below is a partial aging of accounts receivable for Bitar Roofing Services. Fill in the rest of the information and determine Bitar's days' sales outstanding. How does it compare to the industry average of 40 days?

Age of Account (days)	Value of Account	% of Total Value
0–10	$211,000	
11–30	120,360	
31–45	103,220	
46–60	72,800	
Over 60	23,740	
Total	$531,120	

14.4 By obtaining a lockbox, Nizam's Manufacturing was able to reduce its total cash collection time by two days. The firm has annual sales of $570,000 and can earn 4.75 percent annual interest. Assuming that the lockbox costs $50 per year, calculate the savings that can be attributed to the lockbox.

14.5 Rockville Corporation is going to borrow $250,000 from its bank at an APR of 8.5 percent. The bank requires its customers to maintain a 10 percent compensating balance. What is the effective interest rate on this bank loan?

Solutions to Self-Study Problems

14.1 We calculate the operating and cash conversion cycles for Blue Ridge Company as follows:

Inventory = $2,890

Accounts receivable = $2,800

Accounts payable = $2,670

Net sales = $24,589

Cost of goods sold = $19,630

$$\text{DSI} = \frac{\text{Inventory}}{\text{COGS}/365} = \frac{\$2{,}890}{\$19{,}630/365} = 53.7 \text{ days}$$

$$\text{DSO} = \frac{\text{Accounts receivable}}{\text{Credit sales}/365} = \frac{\$2{,}800}{\$24{,}589/365} = 41.6 \text{ days}$$

$$\text{DPO} = \frac{\text{Accounts payable}}{\text{COGS}/365} = \frac{\$2{,}670}{\$19{,}630/365} = 49.6 \text{ days}$$

$$\begin{aligned}\text{Operating cycle} &= \text{DSI} + \text{DSO} \\ &= 53.7 \text{ days} + 41.6 \text{ days} \\ &= 95.3 \text{ days}\end{aligned}$$

$$\begin{aligned}\text{Cash conversion cycle} &= \text{DSI} + \text{DSO} - \text{DPO} \\ &= 53.7 \text{ days} + 41.6 \text{ days} - 49.6 \text{ days} \\ &= 45.7 \text{ days}\end{aligned}$$

14.2 Merrifield's days' sales in inventory is calculated as follows:

Operating cycle = 76 days
Accounts receivable = $230,000
Net sales = $1,920,000

$$\text{DSO} = \frac{\text{Accounts receivable}}{\text{Credit sales}/365} = \frac{\$230{,}000}{\$1{,}920{,}000/365} = 43.7 \text{ days}$$

$$\text{Operating cycle} = \text{DSI} + \text{DSO}$$
$$76 \text{ days} = \text{DSI} + 43.7 \text{ days}$$
$$\text{DSI} = 32.3 \text{ days}$$

Merrifield Cosmetics holds inventory an average of 32.3 days before selling it.

14.3 The missing information for Bitar Roofing and its days' sales outstanding are as follows:

Bitar Roofing		
Age of Account (days)	**Value of Account**	**% of Total Value**
0–10	$211,000	39.7%
11–30	120,360	22.7
31–45	103,220	19.4
46–60	72,800	13.7
Over 60	23,740	4.5
Total	$531,120	100.0%

$$\begin{aligned}\text{Effective DSO} &= (0.397 \times 10 \text{ days}) + (0.227 \times 30 \text{ days}) \\ &\quad + (0.194 \times 45 \text{ days}) + (0.137 \times 60 \text{ days}) \\ &\quad + (0.045 \times 365 \text{ days}) \\ &= 3.97 \text{ days} + 6.81 \text{ days} + 8.73 \text{ days} + 8.22 \text{ days} \\ &\quad + 16.43 \text{ days} \\ &= 44.2 \text{ days}\end{aligned}$$

Bitar takes about 4 days longer than the industry average of 40 days to collect on its receivables. The firm should focus collection efforts on all credit sales that take 60 days or more to collect.

14.4 The savings that can be attributed to Nizam's lockbox are:

Annual sales = $570,000
Annual interest rate = 4.75%
Collection time saved = 2 days

$$\text{Average daily sales} = \frac{\$570{,}000}{365} = \$1{,}561.64$$

$$\text{Savings} = (\$1{,}561.64 \times 0.0475 \times 2) - \$50 = \$98.36$$

The firm saves $98.36 each year by using the lockbox.

14.5 The effective rate on Rockville Corporation's loan is calculated as follows:

Amount to be borrowed = $250,000
Stated annual interest rate = 8.5%
Compensating balance = 10%

$$\begin{aligned}\text{Amount deposited as compensating balance} &= \$250{,}000 \times 0.10 \\ &= \$25{,}000\end{aligned}$$

$$\text{Effective amount borrowed} = \$250{,}000 - \$25{,}000 = \$225{,}000$$

$$\text{Interest expense} = \$250{,}000 \times 0.085 = \$21{,}250$$

$$\text{Effective interest rate} = \frac{\$21{,}250}{\$225{,}000} = 9.44\%$$

A compensating balance of 10 percent, or $25,000, on the loan increases the effective interest rate to 9.44 percent.

Discussion Questions

14.1 What factors must a financial manager consider when making decisions about accounts receivable?

14.2 List some of the working capital management practices you would expect to see in a manufacturing company following just-in-time inventory practices.

14.3 What costs would a firm following a flexible current asset management strategy consider, and why?

14.4 How are customers and suppliers affected by a firm's working capital management decisions?

14.5 A beverage bottling company in Vermont has days' sales outstanding of 23.7 days. Is this good? Explain.

14.6 How do the following circumstances affect the cash conversion cycle: (a) favorable credit terms allow the firm to pay its accounts payable slower, (b) inventory turnover increases, and (c) accounts receivable turnover decreases?

14.7 What are some industries in which the use of lockboxes would especially benefit companies? Explain.

14.8 Suppose you are a financial manager at a big firm and you expect interest rates to decline in the near future. What current asset investment strategy would you recommend that the company pursue?

14.9 Why is the commercial paper market available only to the most creditworthy companies?

14.10 Explain what a negative cash conversion cycle means.

Questions and Problems

Basic

14.1 Cash conversion cycle: Wolfgang's Masonry management estimates that it takes the company 27 days on average to pay its suppliers. Management also knows that the company has days' sales in inventory of 64 days and days' sales outstanding of 32 days. How does Wolfgang's cash conversion cycle compare with the industry average of 75 days?

14.2 Cash conversion cycle: Northern Manufacturing Company management found that during the last year it took an average of 47 days to pay its suppliers, whereas it took 63 days to collect its receivables. The company's days' sales in inventory was 49 days. What was Northern's cash conversion cycle?

14.3 Cash conversion cycle: Devon Automotive management estimates that it takes the company 62 days to collect cash from customers on finished goods from the day it receives raw materials, and it takes 65 days to pay its suppliers. What is the company's cash conversion cycle? Interpret your answer.

14.4 Operating cycle: Lilly's Bakery distributes its products to more than 75 restaurants and delis. The company's average collection period is 27 days, and it keeps its inventory for an average of four days. What is Lilly's operating cycle?

14.5 Operating cycle: NetSpeed Technologies is a telecom component manufacturer. The firm typically has a collection period of 44 days and days' sales in inventory of 29 days. What is the operating cycle for NetSpeed?

14.6 Operating cycle: Devlin Construction, Inc., reported the following balance sheet information for the last fiscal year. Devlin also reported net sales of $980,770 and days' sales in inventory of 48.90 days.

Devlin Construction Inc.	
Assets	
Cash and marketable securities	$ 15,032
Accounts receivable	$140,500
Inventories	$289,809
Other current assets	$ 12,647
Total current assets	$457,988

Calculate the firm's operating cycle.

14.7 Current asset management strategy: Describe the risks that are associated with a restrictive current asset management strategy.

14.8 Cost of trade credit: Sybex Corp. sells its goods with terms of 2/10 EOM, net 30. What is the implicit cost of the trade credit?

14.9 Cost of trade credit: Mill Street Corporation sells its goods with terms of 4/10 EOM, net 60. What is the implicit cost of the trade credit?

14.10 Lockbox: Rosenthal Design has daily sales of $59,000. The financial management team has determined that a lockbox would reduce the collection time by 1.6 days. Assuming the company can earn 5.2 percent interest per year, what are the savings from the lockbox?

14.11 Lockbox: Pacific Traders has annual sales of $1,895,000. The firm's financial manager has determined that using a lockbox will reduce collection time by 2.3 days. If the firm's opportunity cost on savings is 5.25 percent, what are the savings from using the lockbox?

14.12 Effective interest rate: The Kellogg Bank requires borrowers to keep an 8 percent compensating balance. Gorman Jewels borrows $340,000 at a 7 percent stated APR. What is the effective interest rate on the loan?

14.13 Effective interest rate: Morgan Contractors borrowed $1.75 million at an APR of 10.2 percent. The loan called for a compensating balance of 12 percent. What is the effective interest rate on the loan?

14.14 Factoring: Maltz Landscaping has an average collection period of 38 days for its accounts receivable. Currently, Maltz factors all of its receivables at a 2 percent discount. What is the effective annual interest rate on the financing from the factor?

14.15 Formal line of credit: Winegartner Cosmetics management is setting up a line of credit at the company's bank for $5 million for up to two years. The interest rate is 5.875 percent and the loan agreement calls for an annual fee of 40 basis points on any unused balance for the year. If the firm borrows $2 million on the day the loan agreement is signed, what is the effective rate for the line of credit?

Intermediate

14.16 Cash conversion cycle: Your boss asks you to compute your company's cash conversion cycle. Looking at the financial statements, you see that the average inventory for the year was $26,300, accounts receivable averaged $17,900, and accounts payable averaged $15,100. You also see that the company had sales of $154,000 and that cost of goods sold was $122,000. Calculate and interpret your firm's cash conversion cycle.

14.17 Cash conversion cycle: Blackwell Automotive, Inc., reported the following financial information for the last fiscal year.

Blackwell Automotive, Inc.

Assets		Liabilities and Equity	
Cash and marketable securities	$ 23,015	Accounts payable and accruals	$163,257
Accounts receivable	$141,258	Notes payable	$ 21,115
		Total current liabilities	$184,372
Inventories	$212,444		
Other current assets	$ 11,223		
Total current assets	$387,940	**Sales and Costs**	
		Net sales	$912,332
		Cost of goods sold	$547,400

Calculate the firm's cash conversion cycle and operating cycle.

14.18 Cash conversion cycle: Elsee, Inc., has net sales of $13 million, and 75 percent of these are credit sales. Its cost of goods sold is 65 percent of annual net sales. The firm's cash conversion cycle is 41.3 days. The inventory balance at the firm is $1,817,344, while its accounts payable balance is $2,171,690. What is the firm's accounts receivable balance?

14.19 Cash conversion cycle: Joanna Handicrafts, Inc., has net sales of $4.23 million with 50 percent being credit sales. Its cost of goods sold is $2.54 million. The firm's cash conversion cycle is 47.9 days, and its operating cycle is 86.3 days. What is the firm's accounts payable?

14.20 Operating cycle: Aviva Technology's operating cycle is 81 days. Its inventory was $134,000 at the end of last year, and the company had cost of goods sold of $1.1 million. How long does it take Aviva to collect its receivables on average?

14.21 Operating cycle: Premier Corp. has net sales of $812,344, and cost of goods sold equal to 70 percent of net sales. If the firm's accounts receivable total $113,902 and its operating cycle is 81.6 days, how much inventory does the firm have?

14.22 Operating cycle: Telecraft Enterprises carries 45 days of inventory in its stores. Last year Telecraft reported net sales of $1,400,000 and the company had receivables of $325,000 at the end of the year. What is the operating cycle at Telecraft?

14.23 Operating cycle: Given the data for Telecraft Enterprises in Problem 14.22, re-estimate the firm's operating cycle if days' sales outstanding decreased to 75 days. For the same level of net sales, what is the implied dollar value of receivables with 75 days' sales outstanding?

14.24 Days' sales outstanding: Sliver Computing, Inc., reported the following balance sheet information for the last fiscal year. Sliver Computing also reported cost of goods sold of $291,240 for the same period. Internal auditors state that the firm's cash conversion cycle is 21.53 days.

Sliver Computing Inc.

Assets		Liabilities	
Cash and marketable securities	$ 94,032	Accounts payable	$ 68,561
Accounts receivable	$160,684	Notes payable	$136,320
		Total current liabilities	$204,881
Inventories	$ 19,809		
Other current assets	$ 647		
Total current assets	$275,172		

Calculate the firm's days' sales outstanding.

14.25 Economic order quantity: Longhorn Traders is one of the largest RV dealers in Austin, Texas, and sells about 2,800 recreational vehicles a year. The cost of placing an order with Longhorn's supplier is $800, and the inventory carrying costs are $150 for each RV. Management likes to maintain safety stock of 12 RVs. Most of its sales are made in either the spring or the fall. How many orders should the firm place this year?

14.26 Effective interest rate: The Clarkson Designer Company management wants to borrow $750,000. The bank will provide the loan at an APR of 6.875. Since the loan calls for a compensating balance, the effective interest rate is actually 9.25 percent. What is the compensating balance on this loan?

14.27 Effective interest rate: The Colonial Window Treatments Company is borrowing $1.5 million. The loan requires a 10 percent compensating balance, and the effective interest rate on the loan is 9.75 percent. What is the stated APR on this loan?

14.28 Formal line of credit: Gruppa, Inc., has just set up a formal line of credit of $10 million with First Community Commercial Bank. The line of credit is good for up to five years. The bank will charge Gruppa an interest rate of 6.25 percent on any amount borrowed, and the firm will pay an annual fee of 60 basis points on the unused balance. The firm borrowed $7.5 million on the first day the credit line became available. What is the effective interest rate on this line of credit?

14.29 Formal line of credit: Lansdowne Electronics has a formal line of credit of $1 million for up to three years with HND Bank. The interest rate on the loan is 5.3 percent, and under the agreement, Lansdowne has to pay an annual fee of 50 basis points on the unused amount. Suppose the firm borrows $675,000 the first day of the agreement. What is the fee the company must pay on the unused balance? What is the effective interest rate?

14.30 Lockbox: Jennifer Electrical is evaluating whether a lockbox it is currently using is worth keeping. Management estimates that the lockbox reduces the mail float by 1.8 days and the processing by half a day. The remittances average $50,000 a day for Jennifer Electrical, with the average check being for $500. The bank charges $0.34 per processed check. Assume that there are 270 business days in a year and that the firm's opportunity cost for these funds is 6 percent. What will the firm's savings be from using the lockbox?

14.31 Lockbox: Hazel Corp. has just signed up for a lockbox. Management expects the lockbox to reduce the mail float by 2.1 days. Hazel Corp.'s remittances average $37,000 a day, and the average check is $125. The bank charges $0.37 per processed check. Assume that there are 270 business days in a year. What will the firm's savings be from using the lockbox if the opportunity cost for these funds is 12 percent?

14.32 Aging schedule: Ginseng Company collects 50 percent of its receivables in 10 days or fewer, 31 percent in 11 to 30 days, 7 percent in 31 to 45 days, 7 percent in 46 to 60 days, and 5 percent in more than 60 days. The company has $1,213,000 in accounts receivable. Prepare an aging schedule for Ginseng Company.

14.33 Aging schedule: A partial aging of accounts receivable for Lincoln Cleaning Services is given in the accompanying table. What percent of receivables is in the 45-day range? Determine the firm's effective days' sales outstanding. How does it compare with the industry average of 35 days?

Age of Account (days)	Value of Account	% of Total Value
10	$271,000	
30	$145,220	
45		
60	$ 53,980	
75	$ 31,245	
Total	$589,218	100.0%

14.34 **Aging schedule:** Keswick Fencing Company collects 45 percent of its receivables in 10 days or fewer, 34 percent in 10 to 30 days, 12 percent in 31 to 45 days, 5 percent in 46 to 60 days, and 4 percent in more than 60 days. The company has $937,000 in accounts receivable. Prepare an aging schedule for Keswick Fencing.

14.35 **Factoring:** Zenex, Inc., sells $250,000 of its accounts receivable to factors at a 3 percent discount. The firm's average collection period is 90 days. What is the dollar cost of the factoring service? What is the simple annual interest cost of the factors loan?

14.36 **Factoring:** A firm sells $100,000 of its accounts receivable to factors at a 2 percent discount. The firm's average collection period is one month. What is the dollar cost of the factoring service?

Advanced

14.37 What impact would the following actions have on the operating and cash conversion cycles? Would the cycles increase, decrease, or remain unchanged?

- **a.** More raw material than usual is purchased.
- **b.** The company enters into an off season, and finished goods inventory builds up.
- **c.** Better terms of payment are negotiated with suppliers.
- **d.** The cash discounts offered to customers are decreased.
- **e.** All else remaining the same, an improvement in manufacturing technique decreases the cost of goods sold.

14.38 What impact would the following actions have on the operating and cash conversion cycles? Would the cycles increase, decrease, or remain unchanged?

- **a.** Less raw material than usual is purchased.
- **b.** The company encounters unseasonable demand, and inventory declines rapidly.
- **c.** Tighter terms of payment are demanded by suppliers.
- **d.** The cash discounts offered to customers are increased.
- **e.** All else remaining the same, due to labor turnover and poor efficiency, the cost of goods sold increases.

14.39 Morgan Sports Equipment Company just reported the following financial information.

Morgan Sports Equipment Company

Assets		Liabilities and Equity	
Cash	$ 677,423	Accounts payable	$1,721,669
Accounts receivable	$1,845,113	Notes payable	2,113,345
Inventories	1,312,478	Total current liabilities	$3,835,014
Total current assets	$3,835,014	**Sales and Costs**	
		Net sales	$9,912,332
		Cost of goods sold	$5,947,399

- **a.** Calculate the firm's days' sales outstanding.
- **b.** What is the firm's days' sales in inventory?
- **c.** What is the firm's days' payables outstanding?
- **d.** What is the firm's operating cycle? How does it compare with the industry average of 72 days?
- **e.** What is the firm's cash conversion cycle? How does it compare with the industry average of 42 days?

14.40 Jackson Electrical, one of the largest generator dealers in Phoenix, sells about 2,000 generators a year. The cost of placing an order with its supplier is $750, and the inventory carrying costs are $170 for each generator. Jackson likes to maintain safety stock of 15 generators at all times.

- **a.** What is the firm's EOQ?
- **b.** How many orders will the firm need to place this year?
- **c.** What is the average inventory for the season?

14.41 Tanzaniqe, Inc., sells $200,000 of its accounts receivable to factors at a 5 percent discount. The firm's average collection period is 90 days.

- **a.** What is the dollar cost of the factoring service?
- **b.** What is the simple annual interest cost of the loan?
- **c.** What is the effective annual interest cost of the loan?

CFA Problems

14.42 A company increasing its credit terms for customers from 1/10, net 30 to 1/10, net 60 will likely experience:

- **a.** An increase in cash on hand.
- **b.** An increase in the average collection period.
- **c.** Higher net income.
- **d.** A higher level of uncollectible accounts.

14.43 Suppose a company uses trade credit with the terms of 2/10, net 50. If the company pays its account on the 50th day, the effective borrowing cost of skipping the discount on Day 10 is closest to

a. 14.6 percent.

b. 14.9 percent.

c. 15.0 percent.

d. 20.2 percent.

The following information relates to Problems 14.44 through 14.46.

Mary Gonzales is evaluating companies in the office supply industry and has compiled the following information:

	2016		2017	
Company	Credit Sales	Average Receivables Balance	Credit Sales	Average Receivables Balance
A	$ 5.0 million	$1.0 million	$ 6.0 million	$1.2 million
B	$ 3.0 million	$1.2 million	$ 4.0 million	$1.5 million
C	$ 2.5 million	$0.8 million	$ 3.0 million	$1.0 million
D	$ 0.5 million	$0.1 million	$ 0.6 million	$0.2 million
Industry	$25.0 million	$5.0 million	$28.0 million	$5.4 million

14.44 Which of the companies has the lowest accounts receivable turnover in 2017?

a. Company A.

b. Company B.

c. Company C.

d. Company D.

14.45 The industry average receivables collection period:

a. Increased from 2016 to 2017.

b. Decreased from 2016 to 2017.

c. Did not change from 2016 to 2017.

d. Increased along with the increase in the industry accounts receivable turnover.

14.46 Which of the companies reduced the average time it took to collect on accounts receivable from 2016 to 2017?

a. Company A.

b. Company B.

c. Company C.

d. Company D.

Sample Test Problems

14.1 The Whole Foods Market, Inc., balance sheet for the fiscal year ending September 25, 2016 included the following: total current assets of $1,975 million, total assets of $6,341 million, total current liabilities of $1,341 million, and total liabilities of $3,117 million. What was the company's net working capital on September 25, 2016? What does this tell us?

14.2 Last year Perpetual Plastics Company took an average of 46 days to pay suppliers and 38 days to collect its receivables. The company's average days' sales in inventory was 52 days. What was Perpetual's operating cycle and cash conversion cycle last year?

14.3 Montrose, Inc., sells its products with terms of 3/15 EOM, net 30. What is the cost of the trade credit it provides its customers?

14.4 FRA Manufacturing Company purchases 9,000 units of Part 3BX each year. The cost of placing an order is $5 and the cost of carrying one part in inventory for a year is $1. What is the economic order quantity (EOQ) for part 3BX if the company carries a safety stock of 200 units? How many orders will the company need to place each year?

14.5 Rosemary Corporation has daily sales of $139,000. The financial manager at the firm has determined that a lockbox would reduce collection time by 2.2 days. Assuming the company can earn 5.5 per-cent interest per year, what are the potential annual savings from the lockbox?

14.6 Sunny Way Landscaping has a formal line of credit of $500,000 with First Commerce Bank. The interest rate on the loan is 6 percent, and under the agreement Sunny Skies must pay an annual fee of 75 basis points on the unused amount. The amount currently outstanding on the loan is $325,000. What is the annual fee the company must pay on the current unused balance? What is the effective interest rate?

EXHIBIT 15.1 **Venture Capital Industry Characteristics, 2009–2016**

At the end of 2016, there were 898 venture capital firms and 1,562 separate venture capital funds in the United States. The funds had an average of $213.5 million of investable capital. Venture capital firms invested a total of $69.0 billion in 8,136 deals during 2016. The number of firms and funds, and the level of investment activity, increased over the 2009–2016 period.

	Venture Capital Firms and Funds			Investments by Venture Capital Firms	
Year	Number of firms[a]	Total Number of Existing Funds	Average Fund Size ($ millions)	Number of Deals	Total Dollar Value ($ billions)
2009	791	1,276	$204.8	4,458	$26.0
2010	791	1,294	194.3	5,411	31.0
2011	815	1,344	202.6	6,771	44.0
2012	844	1,372	194.7	7,987	41.0
2013	869	1,408	190.3	9,326	45.0
2014	898	1,481	194.8	10,550	69.0
2015	906	1,528	206.3	10,468	79.0
2016	898	1,562	213.5	8,136	69.0
Average	852	1,408	$200.2	7,888	$50.5

[a]Number of firms that had raised funds in the previous eight years.
Source: National Venture Capital Association 2017 Yearbook.

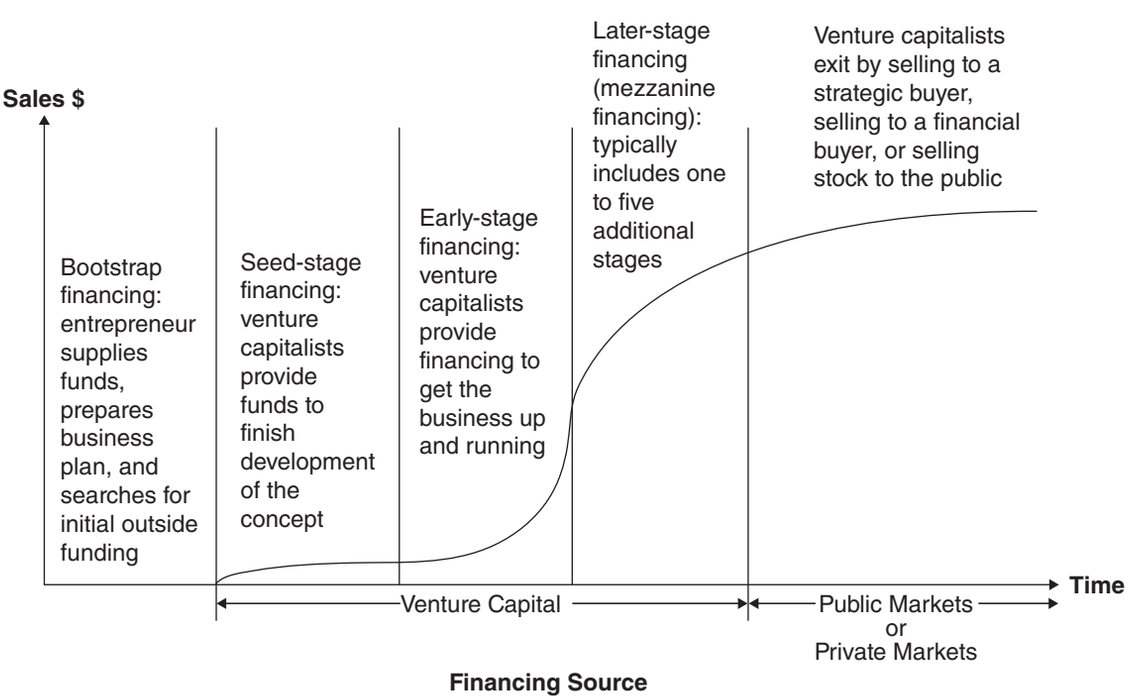


EXHIBIT 15.2 **The Venture Capital Funding Cycle**

The typical venture capital funding cycle begins when the entrepreneur runs low on bootstrap financing. Venture capitalists then provide equity financing. They will later exit through a private or public sale of their equity. The duration of the cycle is typically three to seven years, and only a small percentage of new ventures make it all the way to the end.

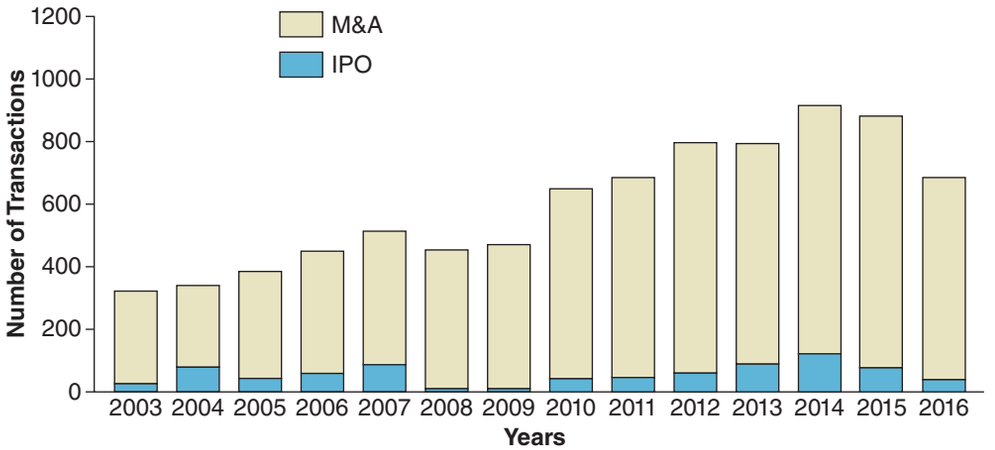


EXHIBIT 15.3 **Strategic and Financial Sales and Venture-Backed IPO Exits in the United States, 2003–2016**

Comparing the number of strategic and financial (M&A) sales of new businesses with the number of venture-backed IPOs from 2003 through 2016 shows that strategic and financial sales were far more common than IPOs during this period.

Source: National Venture Capital Association 2017 Yearbook.

LEARNING BY DOING

APPLICATION 15.1 | An Unsuccessful IPO

Problem Let's continue with our IPO example from the text. Suppose that the stock sale is not successful and the underwriter is able to sell the stock, on average, for only $19 per share. If the underwriter buys the stock from the issuer for $18.60, what will be the proceeds for each party from the sale?

Approach Because the underwriting is a firm-commitment offering, the underwriter guarantees that the issuer will receive the full expected amount, as calculated in the text. The underwriter will have to absorb the entire loss.

Solution The total proceeds from the sale are $19 per share. Since the issuer still receives $18.60 per share because of the firm-commitment offering, the issuer receives total proceeds of $18.60 per share × 2 million shares = $37.2 million. By comparison, underwriter receives $0.40 per share. Its total proceeds from the sale are $0.8 million ($0.40 per share × 2 million shares = $0.8 million) rather than the expected $2.8 million. The total proceeds for the IPO sale are $38 million ($37.2 million + $0.8 million = $38.0 million).

LEARNING BY DOING

APPLICATION 15.2 | A Best-Effort IPO

Problem Now let's assume that the stock in our IPO is sold on a best-effort basis and that the underwriter agrees to a spread of 7 percent of the selling price. The average selling price remains at $19 per share. What are the net proceeds for the issuer and the underwriter in this best-effort offering?

Approach The key to working this problem is recognizing that in a best-effort IPO, the underwriter bears no risk. The risk of an unsuccessful sale is borne entirely by the issuing firm. Thus, the underwriter is paid first, and the residual goes to the issuer.

Solution Since the underwriter agreed to a spread of 7 percent of the price at which each share of stock is sold, the distribution of the proceeds can be calculated as follows: The underwriter's spread for each share sold is $1.33 per share ($19.00 per share × 0.07 = $1.33 per share). The firm's total net proceeds are $35.34 million [($19.00 per share × 0.93) × 2 million shares = $35.34 million], and the underwriter's total proceeds are $2.66 million ($1.33 per share × 2 million shares = $2.66 million). The total proceeds from the IPO sale are still $38 million, but are distributed differently.

EXHIBIT 15.4 **Initial Public Offerings, Gross Proceeds, and Returns, 1997–2016**

This exhibit summarizes the number of IPOs per year, the gross proceeds, and the average first-day returns to investors from all IPOs for the 1997–2016 period. The average first-day return represents the amount of underpricing. The exhibit illustrates the substantial variation in IPO activity and underpricing in the U.S. public equity markets during this period.

Year	Number of IPOs	Gross Proceeds ($ billions)	Avg First Day Return (%)[a]
1997	474	$31.8	14.4%
1998	281	33.7	15.6
1999	477	65.0	57.1
2000	381	64.9	46.0
2001	79	34.2	8.7
2002	66	22.0	5.1
2003	63	9.5	10.4
2004	173	31.2	12.4
2005	159	28.2	9.3
2006	157	30.5	13.0
2007	159	35.7	13.9
2008	21	22.8	24.8
2009	41	13.2	11.1
2010	91	29.8	6.2
2011	81	27.0	13.0
2012	93	31.1	8.9
2013	157	38.8	20.5
2014	206	42.2	12.8
2015	115	21.7	18.7
2016	74	12.1	14.4
Average	167	$31.3	21.1%

[a]Average returns are calculated as the weighted average where the dollar amount of each issue is the weight.

Source: Jay R. Ritter, Table 1 in unpublished note titled "Initial Public Offerings: Updated Statistics," dated February 20, 2017.

EXHIBIT 15.5 **Costs of Issuing an IPO, 2001–2016**

This exhibit shows IPO costs in the United States for the period from 2001 to 2016, by the total value of the shares issued. IPO costs include the direct costs associated with the underwriter's spread and out-of-pocket expenses plus the costs of underpricing (represented by the average first-day return). As you can see, underpricing costs tend to be higher in larger issues, while direct costs decline as the size of the issue increases.

Value of Issue ($ millions)	Number of IPOs	Direct Cost[a] (%)	Average First-Day Return[b] (%)
$2–9.99	24	16.46%	−0.27%
$10–19.99	65	11.37	10.20
$20–39.99	126	9.18	6.40
$40–59.99	190	8.28	9.65
$60–79.99	216	7.88	11.74
$80–99.99	199	7.70	19.78
$100–199.99	402	7.56	17.84
$200–499.99	306	6.47	12.72
$500 and over	127	5.35	11.44
All issues	1,655	8.92%	11.06%

[a]Direct costs (underwriting spread plus out-of pocket expenses).

[b]Average first-day returns are reported as a percent of the issue price.

Source: Securities Data Corporation and author estimates.

EXAMPLE 15.1 | Pricing an IPO

DECISION MAKING

Situation You are the CFO of a small firm that is planning an IPO. You are meeting with your investment banker to discuss the offer price for your common-stock issue. The investment banker tells you that an IPO pricing model indicates that the current value of your stock is $20 per share. Furthermore, a firm with similar risk characteristics completed an IPO two months ago, and its stock price suggests a current market price of $21 per share. The investment banker says that the offer price should be set at $15 per share. What decision should you make with regard to the investment bank's offer price?

Decision Given the available information, you should be cautious about accepting the proposed offer price of $15 per share. The investment bank's IPO pricing model estimates that your stock's current market value is $20 per share. This estimate is validated by the fact that it is very close to the price of the similar firm's stock. If you sold the stock for $15 and the closing price at the end of the first day was $20, the first-day return would be 33.3 percent [($20 − $15)/$15 = 0.333, or 33.3 percent], which is on the upper end of the first-day returns in Exhibit 15.4. Unless your IPO is unusual in some way—for example, you are issuing a large number of shares or the stock price is highly uncertain—a more reasonable price might be $18 per share. With a price of $18 you would expect a first-day return of 11.1 percent [($20 − $18)/$18 = 0.111, or 11.1 percent].

LEARNING BY DOING

APPLICATION 15.3 | The Cost of an IPO

Problem Suppose that Madrid Electronics from Madrid, New Mexico, sells $70 million of stock at $50 per share in an IPO. The underwriter's spread is 7 percent, and the firm's legal fees, SEC registration fees, and other out-of-pocket costs are $200,000. The firm's stock price increases 15 percent on the first day of trading. In dollars, what is the total cost to the firm of issuing the stock?

Approach To calculate the total cost to the firm of issuing the stock, we must consider all three major costs associated with bringing it to market: underwriting spread, out-of-pocket expenses, and underpricing.

Solution

1. *Underwriting spread:* The underwriter's spread is $3.50 per share ($50.00 per share × 0.07 = $3.50 per share). The number of shares sold is 1.4 million ($70 million/$50.00 per share = 1.4 million shares). Thus, the underwriting cost is $4.9 million ($3.50 per share × 1.4 million shares = $4.9 million).
2. *Out-of-pocket expenses:* The out-of-pocket expenses are $200,000.
3. *Underpricing:* The dollar amount of underpricing is computed as follows. The firm's stock was offered at $50.00 and increased to $57.50 per share ($50.00 per share × 1.15 = $57.50 per share) during the first day of trading; thus, the first-day underpricing is $7.50 per share ($57.50 per share − $50.00 per share = $7.50 per share). The total underpricing is $10.5 million ($7.50 per share × 1.4 million shares = $10.5 million).

The total cost to the firm of the IPO is $15.6 million, which consists of the following: (1) $4.9 million in underwriting fees, (2) $0.2 million out-of-pocket expenses, and (3) $10.5 million in underpricing.

DECISION MAKING

EXAMPLE 15.2 | Method of Sale

Situation You are the CFO of a firm that plans to issue a number of securities during the upcoming year. You expect market conditions to remain stable during this period. To obtain the lower funding costs, which method of sale—competitive or negotiated—will you choose for the issues listed in the following?

a. An issue of common stock.
b. A 20-year bond with a fixed-rate coupon.
c. A 20-year revenue bond to fund a manufacturing facility in Brazil; payment of interest and principal is tied to revenues earned by the new facility.
d. A 10-year fixed-rate bond sold from a shelf registration issue.

Decision The method of sale that would more likely achieve the lower funding cost for each of the proposed security issues is as follows:

a. Negotiated sale, because negotiated sales are generally better for equity issues.
b. Competitive sale, because this is a vanilla bond, and competitive sales are more cost-effective for these standardized bond issues.
c. Negotiated sale, because this bond issue involves several complexities.
d. Competitive sale, because this is another vanilla bond.

EXHIBIT 15.6 **Average Gross Underwriting Spread and Out-of-Pocket Expenses as a Percentage of Amount Raised for Public Offerings, 1977–2001**

You can see from this exhibit that issuing common stock is the most expensive method of obtaining funds, while issuing corporate bonds (debt) is the least expensive. The higher cost for the stock issues reflects the greater underwriting risk (higher sales commissions) and the higher out-of-pocket expenses required to bring equity securities to market. For all three types of securities shown—common stock, preferred stock, and bonds—there are economies of scale; as issue size increases, total issue cost, as a percent of the amount raised, declines.

	Common Stock			Preferred Stock			Bonds		
Principal Amount ($ millions)	Gross Underwriting Spread (%)	Out-of-Pocket Expenses (%)	Total (%)	Gross Underwriting Spread (%)	Out-of-Pocket Expenses (%)	Total (%)	Gross Underwriting Spread (%)	Out-of-Pocket Expenses (%)	Total (%)
$0.0–$9.9	7.69%	5.94%	13.63%	4.69%	3.65%	8.34%	2.04%	1.91%	3.95%
$10.0–$24.9	5.99	2.70	8.69	3.05	1.24	4.29	1.29	1.11	2.40
$25.0–$49.9	5.52	1.57	7.09	2.33	0.57	2.90	0.95	0.68	1.63
$50.0–$99.9	5.13	0.89	6.02	2.06	0.28	2.34	0.96	0.43	1.39
$100.0–$199.9	4.68	0.59	5.27	2.76	0.28	3.04	0.90	0.30	1.20
$200.0–$499.9	4.16	0.41	4.57	2.63	0.17	2.80	0.84	0.16	1.00
$500.0 and over	3.49	0.14	3.63	2.62	0.10	2.72	0.57	0.08	0.65

Excludes rights issues, issues callable or putable in under one year, and issues that are not underwritten.
Source: Thomson Reuters.

$$k_l = \text{PR} + \text{DRP} + \text{MAT} \qquad (15.1)$$

LEARNING BY DOING

APPLICATION 15.4 | Pricing a Term Loan

Problem In our text example, Firm B's borrowing cost for a short-term loan is 7.25 percent. Suppose, however, that Firm B's CFO would like to lock in the borrowing cost for five years and asks for a quote on a five-year term loan. The lending officer has access to the following information: a three-month Treasury bill yields 1.00 percent, and five-year Treasury notes yield 2.80 percent. What loan rate should the bank quote?

Approach We first need to find the appropriate MAT, which in this case is the difference between the five-year and three-month Treasury rates. Then, by applying Equation 15.1, we can calculate the five-year term loan rate.

Solution First, we find the MAT:

$$\begin{aligned}\text{MAT} &= \text{5-year Treasury note rate} - \text{3-month Treasury bill rate}\\ &= 2.80\% - 1.00\%\\ &= 1.80\%\end{aligned}$$

We can now apply Equation 15.1:

$$\begin{aligned}k_l &= \text{PR} + \text{DRP} + \text{MAT}\\ &= 4.25\% + 3.00\% + 1.80\%\\ &= 9.05\%\end{aligned}$$

Summary of Key Equations

Equation	Description	Formula
15.1	Bank Loan Pricing Model	$k_l = \text{PR} + \text{DRP} + \text{MAT}$

Self-Study Problems

15.1 Management of Oakley, Inc., is planning to raise $1 million in new equity through a private placement. If the sale price is $18 per share, how many shares does the company have to issue?

15.2 Suppose a firm is doing an IPO and the investment bank offers to buy the securities for $39 per share with an offering price of $42. What is the underwriter's spread? Assume that the underwriter's cost of bringing the security to the market is $1 per share. What is its net profit per share?

15.3 Management of The Stride Rite Corporation, designer and marketer of athletic apparel, is planning an expansion into foreign markets and needs to raise $10 million to finance this move. Management anticipates raising the money through a general cash offering for $13 a share. If the underwriters charge a 5 percent spread, how many shares will the company have to sell to achieve its goal?

15.4 Dean Foods Co. needs to borrow $23 million for a factory equipment upgrade. Management decides to sell 10-year bonds. They determine that the 3-month Treasury bill yields 4.32 percent, the firm's credit rating is AA, and the yield on 10-year Treasury bonds is 1.06 percent higher than that for 3-month bills. Right now, AA bond rates are 1.35 percent above the 10-year Treasury bond rate. What is the borrowing cost for this transaction?

15.5 You are considering starting a new online dating service, but you lack the initial capital. What are your options for obtaining the necessary financing?

Solutions to Self-Study Problems

15.1 To raise $1 million, Oakley will have to issue 55,556 shares ($1,000,000/$18 per share = 55,556 shares).

15.2 Underwriter's spread: $42 − $39 = $3, or 7.1% ($3/$42 = 0.071, or 7.1%)

Net profit per share: $3 − $1 = $2

15.3 Underwriter's spread = 5%

Proceeds per share to the firm = [$13.00 × (1 − 0.05)] = $12.35

To raise $10 million, the company will have to issue 809,717 new shares ($10,000,000/$12.35 per share = 809,717 shares).

15.4 The borrowing cost for Dean Foods can be calculated as follows:

$$k_l = 4.32\% + 1.35\% + 1.06\%$$
$$= 6.73\%$$

The approach used here is similar to that used in the bank loan pricing model.

15.5 Possible sources of capital include your own savings, friends and family, wealthy individuals, venture capital firms, and financial institutions such as banks.

Discussion Questions

15.1 Assume you work for a venture capital firm and have been approached by a couple of recent college graduates with a request to fund their new business. If you are interested in the idea, what process will you follow?

15.2 Identify the three basic services investment bankers provide to help firms bring new security issues to the market. During which stage of the typical IPO does the investment banker take on the risk of the offering? Is there an alternative in which the risk remains with the company going public?

15.3 Define *underpricing*, and explain why the majority of IPOs are underpriced. What role do investment banks play in the price-setting process?

15.4 Explain why the owners of a company might choose to keep it private.

15.5 Identify the three cost components that make up the total cost of issuing securities for a company. Briefly describe each.

15.6 What are the characteristics of a public bond? (Think in terms of comparing it to private placement and bank term loans.)

15.7 Discuss the advantages of shelf registration. What kinds of securities are most likely to be registered this way?

15.8 Identify whether each of the following factors implies a lower or higher price for a bond.

- **a.** Low marketability of the security.
- **b.** Short term to maturity.
- **c.** Low credit rating of the issuer.
- **d.** No call provision.

15.9 Explain why time might play a significant role during low-interest periods in a decision of whether to choose a private placement or public sale.

15.10 Managers at a large firm are looking for a medium-size loan with a long term to maturity and low liquidity. Which of the following types of debt would be the most appropriate?

- **a.** Public bond.
- **b.** Private placement.
- **c.** Bank term loan.

Questions and Problems

Basic

15.1 Venture capital: What items in a business plan does a venture capitalist look for in deciding whether to provide initial financing?

15.2 Venture capital: You finally decide to act on your brilliant idea and start an online textbook rental company. You develop a detailed business plan and calculate that you will need about $350,000 of initial funding to get the business going. Luckily for you, you have lined up two venture capital firms offering to supply the funding. What criteria should guide your decision to select one firm over the other?

15.3 Venture capital: What are some viable exit strategies for investors in a start-up company?

15.4 IPO: Briefly describe the IPO process.

15.5 IPO: Based on your knowledge from this and previous chapters, what are some methods an investment banker uses to determine an IPO price? What factors will play a significant role in the calculation?

15.6 IPO: A majority of firms choose a firm-commitment underwriting arrangement rather than a best-effort arrangement for their IPO. Explain why.

15.7 Competitive versus negotiated sale: Why might a negotiated sale be the lowest-cost means of issuing a complex debt security?

15.8 IPO pricing: Trajax, Inc., a high-technology firm in Portland, raised a total of $90 million in an IPO. The company received $27 of the $30 per share offering price. The firm's legal fees, SEC regis-tration fees, and other out-of-pocket costs were $450,000. The firm's stock price increased 17 percent on the first day of trading. What was the total cost to the firm of issuing the securities?

15.9 IPO pricing: Myriad Biotech management plans a $114 mil-lion IPO in which the offering price to the public will be $51 per share. The
company will receive $47.50 per share. The firm's legal fees, SEC registration fees, and other out-of-pocket costs will total $525,000. If the stock price increases 14 percent on the first day of trading, what will be the total cost of issuing the securities?

15.10 Shelf registration: Are the following statements true or false?

- **a.** Shelf registration allows firms to register an inventory of securities for an unlimited time.
- **b.** The securities can be taken off the shelf at any time and sold to the public.
- **c.** Shelf registration reduces flotation and other expenses associated with registration.
- **d.** There is a large penalty if the authorized securities are not issued.
- **e.** A shelf registration can cover multiple securities.

15.11 General cash offer: What are the steps in a general cash offering? Explain each of them.

15.12 General cash offer: Explain the difference between a competitive and negotiated cash sale. Which method of sale is likely to yield the lower funding cost for firms selling plain vanilla bonds in stable markets?

15.13 Issuing securities: Explain what is meant by economies of scale in issuing securities.

15.14 Bank term lending: Explain how term to maturity affects the price of a bank loan.

15.15 Private placement versus public debt offering: Nalco Holding is an international company that operates in 130 countries, has a market capitalization (market value of equity) of $2.3 billion, and reported net income of $45 million on $3.3 billion in revenues last year. The company needs to raise $200 million in debt, and management is deciding between private placement and public offering. What are the advantages and disadvantages of the two alternatives, and which is likely to be the better choice?

15.16 Prime-rate lending: Suppose two firms want to borrow money from a bank for a period of one year. Firm A has excellent credit, whereas Firm B's credit standing is such that it would pay prime + 2 percent. The current prime rate is 6.75 percent, the 30-year Treasury bond yield is 4.35 percent, the 3-month Treasury bill yield is 3.54 percent, and the 10-year Treasury note yield is 4.22 percent. What are the appropriate loan rates for each firm?

15.17 Prime-rate lending: Now suppose that Firm B from Problem 15.16 decides to get a term loan for 10 years. How does this affect the company's borrowing cost?

15.18 Prime-rate lending: Cartco needs to borrow $5 million for an upgrade to its headquarters and manufacturing facility. Management has decided to borrow using a five-year term loan from its existing commercial bank. The prime rate is 3.25 percent, and Cartco's current rating is prime + 2.48 percent. The yield on a five-year U.S. Treasury note is 2.01 percent, and the three-month U.S. Treasury bill rate is 0.09 percent. What is the estimated loan rate for the five-year bank loan?

Intermediate

15.19 Venture capital: You work for a venture capital firm and are approached to finance a new high-tech start-up. While you believe in the business idea, you also believe it is very risky. What strategies can help to mitigate the risk of the invsetment to your firm? Explain how these measures would work.

15.20 IPO: On August 19, 2004, Google completed its IPO of 19.6 million shares to the initial investors at $85.00 per share. The closing price of the stock that same day was $100.34. What was the dollar value of the underpricing associated with the Google IPO?

15.21 IPO: Deere and Bros. is a broker that brings new issues of small firms to the public market. Its most recent deal for Dextra, Inc., had the following characteristics:

Number of shares: 1,000,000 Price to public: $15 per share
Proceeds to Dextra: $13,500,000

The legal fees were $150,000, printing costs were $56,000, and all the other expenses were $72,000. What is the profit or loss for Deere and Bros.?

15.22 IPO: When Global Partners went public in September 2016, the offer price was $22.00 per share and the closing price at the end of the first day was $23.90. The firm issued 4.9 million shares. What was the loss to the company due to underpricing?

15.23 IPO: Bellex Technologies agreed to complete its IPO on a best-effort basis. The company's investment bank demanded a spread of 17 percent of the offer price, which was set at $30 per share. Three million shares were issued; however, the bank's management was overly optimistic and eventually was able to sell all of the stock for only $28 per share. What were the proceeds for the issuer and the underwriter?

15.24 IPO: Suppose a biotech company in Boston, Massachusetts, completes an $85 million IPO priced to the public at $75 per share. The firm receives $72 per share, and the out-of-pocket expenses are $340,000. The stock's closing price at the end of the first day is $84. What is the total cost to the firm of issuing the securities?

15.25 IPO: An online medical advice company just completed an IPO with an investment bank on a firm-commitment basis. The firm

issued 5 million shares of common stock, and the underwriting fees were $1.90 per share. The offering price was $26 per share.

a. What were the total proceeds from the common-stock sale?

b. How much money did the company receive?

c. How much money did the investment bank receive in fees?

15.26 **IPO underpricing:** Suppose that a biotech firm in Pittsburgh raised $120 million in an IPO. The firm received $23 per share, and the stock sold to the public for $25 per share. The firm's legal fees, SEC registration fees, and other out-of-pocket costs were $270,000. The firm's stock price increased 17.5 percent on the first day. What was the total cost to the firm of issuing the securities?

15.27 **Long-term corporate debt:** The 20-year Treasury rate is 4.67 percent, and a firm's credit rating is BB. Suppose management of the firm decides to raise $20 million by selling 20-year bonds. Management determines that since it has plenty of experience, it will not need to hire an investment banker. At present, 20-year BB bonds are selling for 185 basis points above the 20-year Treasury rate, and it is forecast that interest rates will not stay this low for long. What is the cost of borrowing? What role does timing play in this situation?

Sample Test Problems

15.1 Why are traditional sources of funding not usually available for new or emerging businesses?

15.2 A firm is making an initial public offering. The investment bankers agree to a firm-commitment underwriting for 500,000 shares that would be priced to the public at $36 per share. The underwriter's spread is 7 percent. What will be the proceeds for the issuer and the underwriter?

15.3 Hilton Worldwide Holdings Inc. completed an initial public offering on December 12, 2013. The offer price was $20.00 per share, and the closing price at the end of the first day was $21.50. The firm issued 117.6 million shares. What was the loss to Hilton stockholders due to underpricing? Who received this value?

15.4 SMA Inc. is considering issuing the following securities. For which security would a competitive sale be less costly than a negotiated sale under stable market conditions? Why?

a. Plain vanilla bonds.

b. IPO of common stock.

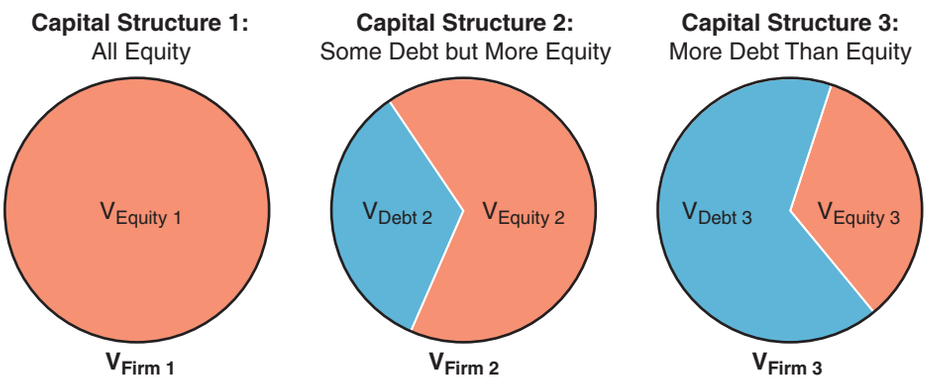
c. Secondary offering of common stock.

d. Convertible bonds.

15.5 Management of Southern Parts Company has decided to sell 10-year bonds to finance expansion into the Pacific Northwest. The market rate on these bonds is 8 percent, and the 3-month Treasury bill rate is 2.1 percent. The firm's credit rating is B, and the yield on 10-year Treasury bonds is 2.5 percent higher than that on 3-month Treasury bills. How much of a premium over the 10-year Treasury bond will these Southern Parts bonds sell for?

Figure 16.1

$$\text{FCF} = [(\text{Revenue} - \text{Op Ex} - \text{D\&A}) \times (1 - t)] \quad + \text{D\&A} \quad - \text{Cap} \quad \text{Exp} - \text{Add} \quad \text{WC}$$



M&M Proposition 1 tells us that $V_{Firm\ 1} = V_{Firm\ 2} = V_{Firm\ 3}$

EXHIBIT 16.1 **Capital Structure and Firm Value under M&M Proposition 1**

The size of the pie represents the present value of the free cash flows that the assets of a firm are expected to produce in the future (V_{Firm}). The sizes of the slices reflect the value of the total cash flows that the debt holders (V_{Debt}) or stockholders (V_{Equity}) are entitled to receive for three different capital structures. Under the three conditions identified by M&M, the total value of the cash flows to the debt holders and stockholders does not change, regardless of which capital structure the firm uses.

$$V_{Firm} = V_{Assets} = V_{Debt} + V_{Equity} \qquad (16.1)$$

Figure 16.2

$$V_{Firm} = \text{PVP} = \frac{\text{CF}}{i} = \frac{\$100}{0.1} = \$1{,}000$$

APPLICATION 16.1 | Undoing the Effects of a Financial Restructuring on Your Own

LEARNING BY DOING

Problem You own 5 percent of the stock in a company that is financed with 80 percent equity and 20 percent debt. Like Millennium Motors, the company generates cash flows of $100 per year before any interest payments and has a total value of $1,000. Management has announced plans to increase the proportion of debt in the firm's capital structure from 20 percent to 30 percent by borrowing $100 and paying a special dividend equal to that amount. Assume that the interest rate on debt is 5 percent regardless of how much debt the company has. How can you undo the effect of the financial restructuring on the cash flows that you receive in your personal account? Show that when you do this, your cash flows after the restructuring are the same as they were before.

Approach As illustrated in the example in the text, you can undo the effect of this restructuring by using all of the money you receive from the special dividend to purchase some of the firm's debt. To show that the cash flows you are entitled to receive remain unchanged, you must calculate the dividends and interest you are entitled to receive before the financial restructuring and afterward.

Solution Since the company currently has $200 of debt (20 percent × $1,000 = $200), it pays $10 in interest annually (5 percent interest rate × $200 = $10). Therefore, the stockholders receive $90 in dividends each year, and you receive an annual dividend of 5 percent × $90.00 = $4.50 for your 5 percent of the total stockholdings.

When the restructuring takes place, you will receive a special dividend equal to 5 percent of the $100 total special dividend, or $5. Since the company will then have to pay interest of $15 each year (5 percent interest rate × $300 = $15), the total regular dividend after the restructuring will be $85. Your portion of the total regular dividend will be 0.05 × $85.00 = $4.25. Therefore, you will receive $5 up front and a dividend of $4.25 per year thereafter.

If you use the $5 that you receive from the special dividend to buy $5 (5 percent) of the new debt issue, you will receive $4.25 per year in regular dividends and 5 percent × $5.00 = $0.25 in interest, for a total of $4.50. This is exactly what you were receiving before the company restructured.

Figure 16.3

$$\text{WACC} = x_{\text{Debt}}\, k_{\text{Debt pretax}}\,(1 - t) + x_{\text{ps}}\, k_{\text{ps}} + x_{\text{cs}}\, k_{\text{cs}}$$

Figure 16.4

$$\text{WACC} = x_{\text{Debt}}\, k_{\text{Debt}} + x_{\text{ps}} k_{\text{ps}} + x_{\text{cs}}\, k_{\text{cs}}$$

$$\text{WACC} = x_{\text{Debt}}\, k_{\text{Debt}} + x_{\text{cs}}\, k_{\text{cs}} \qquad (16.2)$$

Figure 16.5

$$\text{WACC} = k_{\text{Assets}} = \frac{V_{\text{Debt}}}{V_{\text{Debt}} + V_{cs}} k_{\text{Debt}} + \frac{V_{cs}}{V_{\text{Debt}} + V_{cs}} k_{cs}$$

$$k_{cs} = k_{\text{Assets}} + \left(\frac{V_{\text{Debt}}}{V_{cs}}\right)(k_{\text{Assets}} - k_{\text{Debt}}) \qquad (16.3)$$

EXHIBIT 16.2 **Relations between Business Risk, Financial Risk, and Total Equity Risk**

The total risk associated with the cash flows that stockholders are entitled to receive reflects the risk related to the firm's assets (business risk) and the risk related to the way those assets are financed (financial risk). (We assume here that net income is a reasonable measure of these cash flows.)

Revenue	
− Cost of goods sold	
Gross profit	Business risk
− Selling, general & admin. expenses	
− Operating profit	×
− Interest expense	
Earnings before tax	Financial risk
− Income tax	=
= Net income	Total equity risk

EXHIBIT 16.3 **Illustration of Relations between Business Risk, Financial Risk, and Total Risk**

The exhibit shows how a decrease in revenue affects net income (total equity risk) for four different combinations of debt financing (financial risk) and operating leverage (business risk). In columns 1 and 2, we see the effect on a firm with no debt and low operating leverage; in columns 3 and 4, no debt and high operating leverage; in columns 5 and 6, debt and low operating leverage; and in columns 7 and 8, debt and high operating leverage. As you can see, total equity risk, represented by the percent drop in net income, is greater when operating leverage is higher (for example, compare columns 1 and 2 with columns 3 and 4) and when a firm has financial risk (for example, compare columns 1 and 2 with columns 5 and 6). Furthermore, financial risk magnifies operating risk (for example, compare columns 3 and 4 with columns 7 and 8).

	No Financial Risk				Financial Risk			
	Low Operating Leverage		High Operating Leverage		Low Operating Leverage		High Operating Leverage	
Column	1	2	3	4	5	6	7	8
Fixed costs as a percent of total costs	20%		60%		20%		60%	
Interest expense	$0.00		$0.00		$15.00		$15.00	
	Before	**After**	**Before**	**After**	**Before**	**After**	**Before**	**After**
Revenue	$100.00	$80.00	$100.00	$80.00	$100.00	$80.00	$100.00	$ 80.00
− Cost of goods sold (VC)	60.00	48.00	30.00	24.00	60.00	48.00	30.00	24.00
Gross profit	$ 40.00	$32.00	$ 70.00	$56.00	$ 40.00	$32.00	$ 70.00	$ 56.00
− Selling, general, & admin. (FC)	15.00	15.00	45.00	45.00	15.00	15.00	45.00	45.00
Operating profits	$ 25.00	$17.00	$ 25.00	$11.00	$ 25.00	$17.00	$ 25.00	$ 11.00
− Interest expense	0.00	0.00	0.00	0.00	15.00	15.00	15.00	15.00
Earnings before tax	$ 25.00	$17.00	$ 25.00	$11.00	$ 10.00	$ 2.00	$ 10.00	−$4.00
− Income taxes (35%)	8.75	5.95	8.75	3.85	3.50	0.70	3.50	− 1.4
Net income	$ 16.25	$11.05	$ 16.25	$ 7.15	$ 6.50	$ 1.30	$ 6.50	−$2.60
Percent change in net income		−32%		−56%		−80%		−140%

Figure 16.6

$$k_{cs} = k_{Assets} + \left(\frac{V_{Debt}}{V_{cs}}\right)(k_{Assets} - k_{Debt})$$
$$= 0.10 + \left(\frac{0.2}{0.8}\right)(0.10 - 0.05)$$
$$= 0.1125, \text{ or } 11.25\%$$

LEARNING BY DOING

APPLICATION 16.2 | Using M&M Proposition 2 to Calculate k_{cs}

Problem The required rate of return on the assets of Tempe Technologies is 8 percent, the firm has a debt-to-common-stock ratio of 30 percent, and the cost of debt is 5 percent. If the firm has no preferred stock and the three conditions specified by M&M hold, what is the expected rate of return on the firm's common stock?

Approach The expected return on the firm's common stock can be calculated using Equation 16.3.

Solution

$$\begin{aligned} k_{cs} &= k_{Assets} + \left(\frac{V_{Debt}}{V_{cs}}\right)(k_{Assets} - k_{Debt}) \\ &= 0.08 + (0.30)(0.08 - 0.05) \\ &= 0.089, \text{ or } 8.9\% \end{aligned}$$

Figure A. Constant Cost of Debt

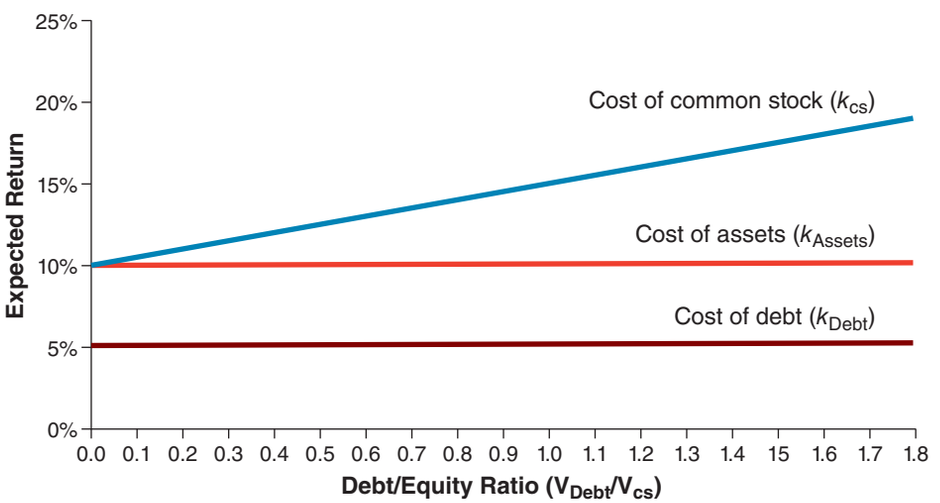


Figure B. Changing Cost of Debt

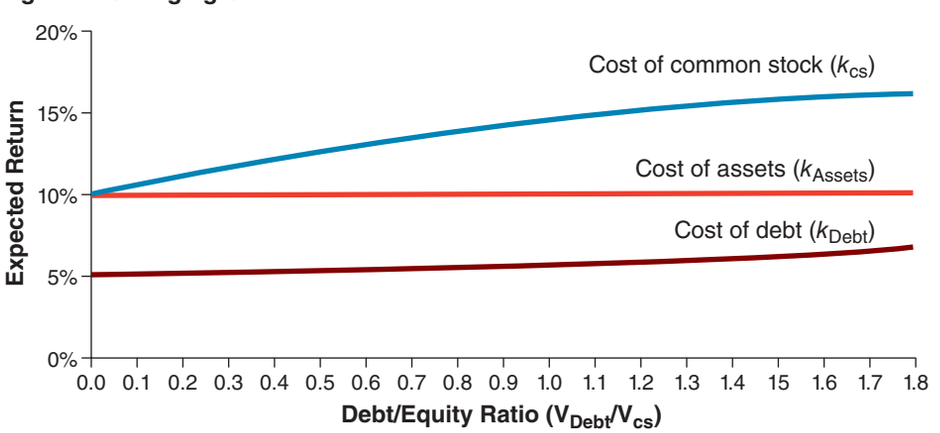


EXHIBIT 16.4 **Illustrations of M&M Proposition 2**

The costs of assets, common stock, and debt for different debt-to-equity ratios. Figure A assumes that the cost of debt remains constant, and Figure B assumes that the cost of debt increases with leverage. The cost of assets, which is the return that investors require to compensate them for business risk, does not change with leverage. As M&M Proposition 2 tells us, the cost of common stock increases with leverage.

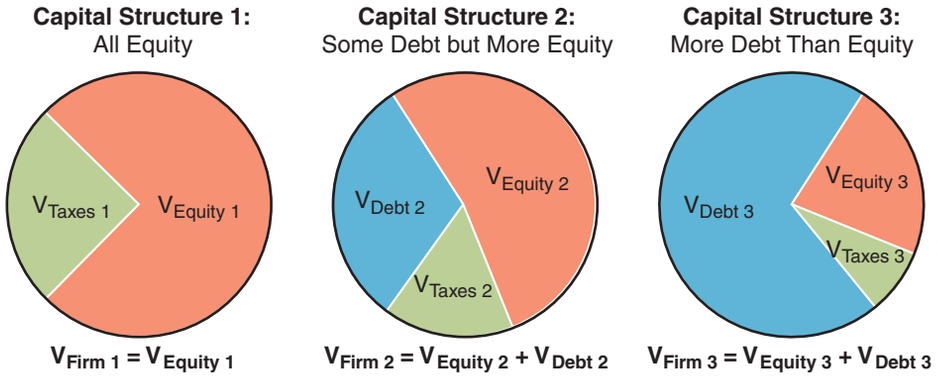


EXHIBIT 16.5 **Capital Structure and Firm Value with Taxes**

Leverage can increase the value of a firm when interest payments are tax deductible but dividend payments are not. The pie on the left represents a firm financed entirely with equity. The slice labeled $V_{Taxes\ 1}$ reflects the proportion of the cash flows from operations that this firm pays in taxes. The two pies to the right illustrate how the value of the cash flows paid in taxes decreases as leverage is increased. By reducing the fraction paid in taxes, leverage increases the value of the firm in these examples.

Figure 16.7

	No Debt	After $1,000 Loan
Government (taxes)	$ 35.00	$ 17.50
Stockholders	65.00	32.50
Debt holders	0.00	50.00
Total	$100.00	$100.00

Figure 16.8

$$V_{\text{Tax-savings debt}} = \text{PVP} = \frac{\text{CF}}{i} = \frac{D \times k_{\text{Debt}} \times t}{i}$$

Figure 16.9

$$V_{\text{Tax-savings debt}} = \frac{D \times k_{\text{Debt}} \times t}{k_{\text{Debt}}} = \frac{\$17.5}{0.05} = \$350$$

$$V_{\text{Tax-savings debt}} = D \times t \qquad (16.4)$$

Figure 16.10

$$V_{\text{Tax-savings debt}} = D \times t$$

$$t = \frac{V_{\text{Tax-savings debt}}}{D} = \frac{\$9.7}{\$25.0} = 0.388, \text{ or } 38.8\%$$

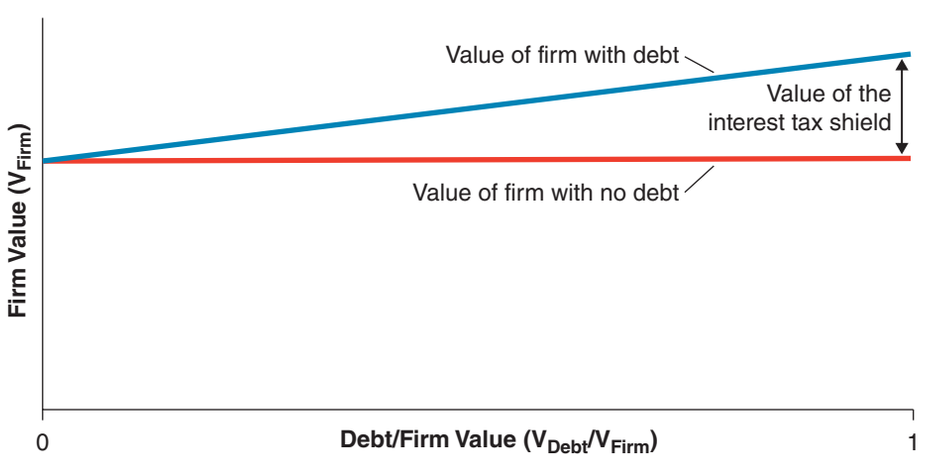


EXHIBIT 16.6 **How Firm Value Changes with Leverage When Interest Payments Are Tax Deductible and Dividends Are Not**

The value of a firm increases with leverage when interest payments are tax deductible and dividend payments are not, and when the second and third M&M conditions—that there are no information or transaction costs and that the real investment policy of the firm is not affected by its capital structure decisions—apply.

Figure 16.11

$$\text{WACC} = x_{\text{Debt}} k_{\text{Debt pretax}}(1 - t) + x_{\text{ps}} k_{\text{ps}} + x_{\text{cs}} k_{\text{cs}}$$
$$= \left(\frac{\$200}{\$720}\right)(0.05)(1 - 0.35) + 0 + \left(\frac{\$520}{\$720}\right)(0.1125) = 0.0903, \text{ or } 9.03\%$$

EXHIBIT 16.7 **The Effect of Taxes on the Firm Value and WACC of Millennium Motors**

The value of Millennium Motors increases and its WACC decreases with the amount of debt in the capital structure. The calculations assume that the cost of debt remains constant regardless of the amount of leverage and that the second and third M&M conditions apply.

	Total debt				
	$0	$200	$400	$600	$800
Cost of debt	5.00%	5.00%	5.00%	5.00%	5.00%
EBIT	$100.00	$100.00	$100.00	$100.00	$100.00
Interest expense	—	10.00	20.00	30.00	40.00
Earnings before taxes	$100.00	$ 90.00	$ 80.00	$ 70.00	$ 60.00
Taxes (35%)	35.00	31.50	28.00	24.50	21.00
Net income	$ 65.00	$ 58.50	$ 52.00	$ 45.50	$ 39.00
Dividends	$ 65.00	$ 58.50	$ 52.00	$ 45.50	$ 39.00
Interest payments	—	10.00	20.00	30.00	40.00
Payments to investors	$ 65.00	$ 68.50	$ 72.00	$ 75.00	$ 79.00
Value of equity	$650.00	$520.00	$390.00	$260.00	$130.00
Cost of equity	10.00%	11.25%	13.33%	17.50%	30.00%
Firm value	$650.00	$720.00	$790.00	$860.00	$930.00
WACC	10.00%	9.03%	8.23%	7.56%	6.99%

LEARNING BY DOING

APPLICATION 16.3 | Calculating the Effect of Debt on Firm Value and WACC

Problem Up to this point, you have financed your pizza chain entirely with equity. You have heard about the tax benefit associated with using debt financing and are considering borrowing $1 million at an interest rate of 6 percent to take advantage of the interest tax shield. You do not need the extra money in the business, so you will distribute it to yourself through a special dividend. You are the only stockholder.

Your pizza business generates taxable (pretax) cash flows of $300,000 each year and pays taxes at a rate of 25 percent; the cost of assets, k_{Assets} (which equals k_{cs} for your unleveraged firm), is 10 percent. What is the value of your firm without debt, and how much would $1 million of debt increase its value if you assume that all cash flows are perpetuities and that the second and third M&M conditions hold (that is, there are no information or transaction costs and the real investment policy of the firm is not affected by its capital structure decisions)? Also, what would the WACC for your business be before and after the proposed financial restructuring?

Approach The value of your restaurant chain equals the present value of the after-tax cash flows that the stockholders and debt holders expect to receive in the future. Without debt, this value equals the present value of the dividends that you can expect to receive as the only stockholder. The value with debt equals the value without debt plus the value of the interest tax shield.

The WACC before the financial restructuring equals k_{cs}, since your firm currently has no preferred stock or debt. Equation 13.7 can be used to calculate the WACC with debt.

Solution The value of your business without debt can be calculated using the perpetuity model as follows:

$$V_{Firm} = [\$300{,}000 \times (1 - 0.25)]/0.10 = \$2{,}250{,}000$$

The value of the tax shield is:

$$D \times t = \$1{,}000{,}000 \times 0.25 = \$250{,}000$$

Therefore, after the restructuring, the value of the firm would be $2.5 million ($2,250,000 + $250,000 = $2,500,000).

The WACC before the financial restructuring equals:

$$WACC = k_{cs} = 10\%$$

To calculate the WACC after the restructuring, we must first calculate the cost of the common stock. Since the values of the firm and debt will be $2.5 million and $1 million, respectively, the value of the equity must equal $1.5 million. The after-tax cash flows to stockholders will equal $180,000 {[$300,000 − ($1,000,000 × 0.06)] × [1 − 0.25] = $180,000}. Therefore, k_{cs} equals 12 percent ($180,000/$1,500,000 = 0.12, or 12 percent). We can now calculate the WACC using Equation 13.7 as follows:

$$\begin{aligned} WACC &= x_{Debt}\, k_{Debt\ pretax}\,(1 - t) + x_{ps}k_{ps} + x_{cs}k_{cs} \\ &= \left(\frac{\$1{,}000{,}000}{\$2{,}500{,}000}\right)(0.06)(1 - 0.25) + 0 + \left(\frac{\$1{,}500{,}000}{\$2{,}500{,}000}\right)(0.12) \\ &= 0.090, \text{ or } 9.0\% \end{aligned}$$

$$k_{cs} = k_{Assets} + (V_{Debt}/V_{cs}) \times (k_{Assets} - k_{Debt})(1 - t) \qquad (16.5)$$

Figure 16.12

$$k_{cs} = k_{Assets} + (V_{Debt}/V_{cs}) \times (k_{Assets} - k_{Debt})(1 - t)$$
$$k_{cs} = 0.10 + (\$1{,}000{,}000/\$1{,}500{,}000) \times (0.10 - 0.06)(1 - 0.25)$$
$$k_{cs} = 0.12 \text{ or } 12\%$$

EXAMPLE 16.1 | Capital Structure and Tax Rates

DECISION MAKING

Situation You are the chief financial officer at Maricopa Manufacturing Company in Phoenix, Arizona. The company is currently financed with 30 percent debt and 70 percent equity. Maricopa's chief lobbyist in Washington, D.C., just told you that he expects the federal government to reduce the top corporate income tax rate from 35 percent to 28 percent beginning next year. What action should you take with regard to Maricopa's capital structure?

Decision Assuming that state and local taxes are not also expected to change next year, the reduction in the top federal corporate income tax rate means that the interest tax shield benefit your company receives from its outstanding debt will decline. If the current capital structure maximizes Maricopa's value when the federal income tax rate is 35 percent and you expect all of the other costs and benefits of debt to remain the same, you should reduce the amount of debt that is used to finance Maricopa when the new tax rate goes into effect. This is because the smaller benefits from debt will be offset by the costs of debt at a lower debt level. Precisely how much you should reduce the company's debt will depend on exactly how large the total benefits and costs will be next year.

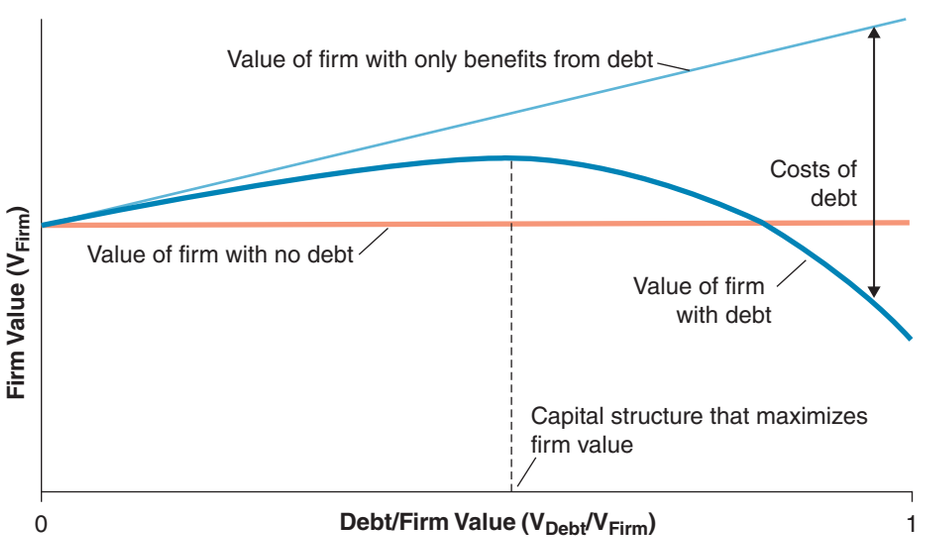


EXHIBIT 16.8 Trade-Off Theory of Capital Structure

The benefits and costs of debt combine to affect firm value. For low levels of debt, adding more debt to a firm's capital structure increases firm value because the additional (marginal) benefits are greater than the additional (marginal) costs. However, at some point, which is the point at which the value of the firm is maximized, the costs of adding more debt begin to outweigh the benefits, and the value of the firm decreases as more debt is added. The difference between the upward-sloping line and the curved line reflects the costs associated with debt.

EXHIBIT 16.9 **Average Capital Structures for Selected Industries in 2016**

This table shows average capital structures for different U.S. industries in 2016. The industries are arranged in order of declining debt-to-firm value ratios, where firm value is estimated as the market value of equity plus the book value of debt. Industries with a great many tangible assets, such as the building construction, air transportation, and printing, publishing, and related industries, tend to have larger debt-to-firm value ratios.

Industry Description	Number of Firms	Debt/Firm Value
Building construction	23	0.46
Gas, electric, and sanitary services	126	0.38
Communications (including telephone companies)	79	0.37
Financial services	500	0.35
Air transportation	19	0.34
Paper and allied product manufacturesrs	25	0.33
Printing, publishing, and related industries	22	0.30
Transportation equipment (including automobiles)	77	0.25
Food stores	12	0.24
Food manufacturers	61	0.19
Business service companies	366	0.14
Electronic and other electrical equipment (including computer) manufacturers	193	0.14
Furniture and fixture manufacturers	19	0.11
Chemicals and allied products (including drug companies)	460	0.11

Source: Estimated by authors using data from the Standard and Poor's Compustat database.

Summary of Key Equations

Equation	Description	Formula
16.1	Value of the firm as the sum of the debt and equity values	$V_{Firm} = V_{Assets} = V_{Debt} + V_{Equity}$
16.2	Formula for the weighted average cost of capital (WACC) for a firm with only debt and common stock and no taxes	$WACC = x_{Debt}k_{Debt} + x_{cs}k_{cs}$
16.3	Cost of common stock in terms of financial leverage, the required return on assets, and the required return on debt	$k_{cs} = k_{Assets} + \left(\frac{V_{Debt}}{V_{cs}}\right)(k_{Assets} - k_{Debt})$
16.4	Value of the tax savings from debt (upper bound)	$V_{Tax\text{-}savings\ debt} = D \times t$
16.5	Cost of common stock with taxes	$k_{cs} = k_{Assets} + \left(\frac{V_{Debt}}{V_{cs}}\right)(k_{Assets} - k_{Debt})(1 - t)$

Self-Study Problems

16.1 If any of the three assumptions in Modigliani and Miller Proposition 1 are relaxed, which has the most predictably quantifiable impact on the value of the firm?

16.2 If we assume that the cash flows for a firm with financial leverage are equal to the cash flows for the same firm without financial leverage, what can we say about the value of this firm if its cost of capital also does not vary with the degree of leverage utilized?

16.3 Are taxes necessary for the cost of debt financing to be less than the cost of equity financing?

16.4 You are offered jobs with identical responsibilities by two different firms in the same industry. One has no debt in its capital structure, and the other has 99 percent debt in its capital structure. Will you require a higher level of compensation from one firm than from the other? If so, which firm will have to pay you more?

16.5 You are valuing two otherwise identical firms in the same industry. One firm has a corporate jet for every executive at the vice president level and above, while the other does not have a single corporate jet. More than likely, which firm has the greater stockholder–manager agency costs?

Solutions to Self-Study Problems

16.1 The assumption with the most measurable impact is that involving taxes. We can calculate the present value of the tax shield generated by the interest costs of borrowing. The impacts of the other two assumptions, though real, are more difficult to predict.

16.2 If the cash flows produced by the firm and the cost of capital for the firm are the same, regardless of the amount of leverage utilized, we can say that the value of the firm is also the same, regardless of the amount of financial leverage.

16.3 The deduction for interest expense does make debt borrowing more attractive than it would otherwise be. However, even without the interest deduction benefit, the cost of debt is less than the cost of equity because equity is a riskier investment than debt. This means that the pretax cost to the firm for debt is still lower than the cost of equity.

16.4 The firm with the large amount of debt financing (the firm with 99 percent debt) has a higher probability of becoming financially distressed. Therefore, you should require greater compensation from that firm because your income is less certain and working at that firm poses a greater risk to your career.

16.5 While corporate jets can make economic sense because they enable managers to use their time more efficiently, one jet per vice president is very unlikely to be cost-effective. The multijet firm most likely has higher stockholder–manager agency costs than the no-jet firm. It is probably spending too much on jets. The cash that is being spent on excess jets could be invested in positive NPV projects or returned to the firm's stockholders.

Discussion Questions

16.1 List and briefly describe the three key assumptions in Modigliani and Miller's Proposition 1 that are required for total firm value to be independent of capital structure.

16.2 Evaluate the statement that the weighted average cost of capital (WACC) for a firm (assuming that all three assumptions of Modigliani and Miller's propositions hold) is always less than or equal to the cost of equity for the firm.

16.3 If the value of the firm remains constant as a function of its capital structure and the three Modigliani and Miller assumptions apply, why might the overall cost of capital change or not change as capital structure changes?

16.4 Consider the WACC for a firm that pays taxes. Explain what the best course of action would be to minimize the firm's WACC and thereby maximize its value. Use the WACC formula for your explanation.

16.5 The Modigliani and Miller propositions, when the no-tax assumption is relaxed, suggest that the firm should finance itself with as much debt as possible. Taking this suggestion to the extreme, is it even possible to finance a firm with 100 percent debt and no equity? Why or why not?

16.6 Crossler Automobiles sells autos in a market where the standard auto comes with a 10-year/100,000-mile warranty on all parts and labor. Describe how an increased probability of bankruptcy could affect sales of autos by Crossler.

16.7 Agency problems occur because the nonowner managers and stockholders of a firm have different interests. Propose a capital structure change that might help better align these different interests.

16.8 If a firm increases its debt to a very high level, then the positive effect of debt in aligning the interests of management with those of stockholders tends to become negative. Explain why this occurs.

16.9 Using the Modigliani and Miller framework, but excluding the assumptions that there are no taxes and no information or transaction costs, describe the value of the firm as a function of the proportion of debt in its capital structure.

16.10 When we observe the capital structure of many firms, we find that they tend to utilize lower levels of debt than that predicted by the trade-off theory. Offer an explanation for this.

Questions and Problems

Basic

16.1 **M&M Proposition 1:** The Modigliani and Miller theory suggests that the value of the firm's assets is equal to the value of the claims on those assets and is not dependent on how the asset claims are divided. The common analogy to the theorem is that the total amount of pie available to be eaten (the firm) does not depend on the size of each slice of pie. If we continue with that analogy, then what if we cut up the pie with a very dull knife such that the total amount of pie available to be eaten is less after it is cut than before it was cut. Which of the three Modigliani and Miller assumptions, if relaxed, is analogous to the dull knife? *Hint:* Think about the process by which investors could undo the effects of a firm's capital structure decisions.

16.2 **M&M Proposition 1:** Describe what exactly is meant when someone is distinguishing between the value of the firm and the value of the equity of the firm.

16.3 **M&M Proposition 1:** Under Modigliani and Miller's Proposition 1, where all three of the assumptions remain in effect, explain how the value of the firm changes due to changes in the proportion of debt and equity utilized by the firm.

16.4 **M&M Proposition 1:** Cerberus Security Company produces a cash flow of $200 per year and is expected to continue doing so in the infinite future. The cost of equity capital for Cerberus is 20 percent, and the firm is financed entirely with equity. Management would like to repurchase $100 in shares by borrowing $100 at a 10 percent annual rate (assume that the debt will also be outstanding into the infinite future). Using Modigliani and Miller's Proposition 1, what is the value of the firm today, and what will be the value of the claims on the firm's assets after the stock repurchase? What will be the rate of return on common stock required by investors after the stock repurchase?

16.5 **M&M Proposition 1:** A firm that is financed completely with equity currently has a cost of capital equal to 15 percent. Assume that the assumptions in Modigliani and Miller's Proposition 1 hold and that the firm's management plans to change its capital structure to 50 percent debt and 50 percent equity. What will be the cost of equity after the change if the cost of debt is 10 percent?

16.6 **M&M Proposition 1:** Swan Specialty Cycles is currently financed with 50 percent debt and 50 percent equity. The firm pays $125 each year to its debt investors (at a 10 percent cost of debt), and the debt has no maturity date. What will be the value of the equity if the firm repurchases all of its debt and raises the funds to do this by issuing equity? Assume that all of the assumptions in Modigliani and Miller's Proposition 1 hold.

16.7 **M&M Proposition 1:** The weighted average cost of capital for a firm, assuming all three Modigliani and Miller assumptions hold, is 10 percent. What is the current cost of equity capital for the firm if the cost of debt for the firm is 8 percent, and the firm is 80 percent financed with debt?

16.8 **Interest tax shield benefit:** Legitron Corporation has $350 million of debt outstanding at an interest rate of 9 percent. What is the dollar value of the tax shield on that debt, just for this year, if Legitron is subject to a 35 percent marginal tax rate?

16.9 **Interest tax shield benefit:** FAJ, Inc., has $500 million of debt outstanding at an interest rate of 9 percent. What is the present value of the tax shield on that debt if it has no maturity and if FAJ is subject to a 30 percent marginal tax rate?

16.10 **Interest tax shield benefit:** Springer Corp. has $250 million of debt outstanding at an interest rate of 11 percent. What is the present value of the interest tax shield if the debt has no maturity and if Springer is subject to a 40 percent marginal tax rate?

16.11 **Interest tax shield benefit:** Structural Corp. currently has a cost of equity capital equal to 15 percent. Assume that the Modigliani and Miller Proposition 1 assumptions hold, with the exception of the assumption that there are no taxes, and that the firm's capital structure consists of 50 percent debt and 50 percent equity. What is the weighted average cost of capital for the firm if the cost of debt is 10 percent and the firm is subject to a 40 percent marginal tax rate?

16.12 **Practical considerations in capital structure choice:** List and describe three practical considerations that concern managers when they make capital structure decisions.

Intermediate

16.13 **M&M Proposition 1:** Keyboard Chiropractic Clinic produces $300,000 of cash flow each year. The firm has no debt outstanding, and its cost of equity capital is 25 percent. The firm's management would like to repurchase $600,000 of its equity by borrowing $600,000 at a rate of 8 percent per year. If we assume that the debt will be perpetual, find the cost of equity capital for Keyboard after it changes its capital structure. Assume that the Modigliani and Miller Proposition 1 assumptions hold.

16.14 **M&M Proposition 1:** Marx and Spender Corp. currently has a WACC of 21 percent. If the cost of debt capital for the firm is 12 percent and the firm is currently financed with 25 percent debt, then what is the current cost of equity capital for the firm? Assume that the assumptions in Modigliani and Miller's Proposition 1 hold.

16.15 **M&M Proposition 1:** What is the effect on Modigliani and Miller's Proposition 1 of relaxing the assumption that there are no information or transaction costs?

16.16 **M&M Proposition 1:** The weighted average cost of capital for a firm (assuming all three Modigliani and Miller Proposition 1 assumptions apply) is 15 percent. What is the current cost of equity capital for the firm if its cost of debt is 10 percent and the proportion of debt to total firm value for the firm is 0.5?

16.17 **M&M Proposition 2:** Mikos Processed Foods is currently valued at $500 million. Mikos will repurchase $100 million of its equity by issuing perpetual debt at an annual interest rate of 10 percent. Mikos is subject to a 30 percent marginal tax rate. If the Modigliani and Miller assumptions apply, except the assumption that there are no taxes, what will the value of Mikos be after the recapitalization?

16.18 **M&M Proposition 2:** Backwards Resources Company has a WACC of 12.6 percent, and it is subject to a 40 percent marginal tax rate. Backwards has $250 million of debt outstanding at an interest rate of 9 percent and $750 million of equity (at market value) outstanding. What is the expected return on the equity with this capital structure?

16.19 **The costs of debt:** Briefly discuss costs of financial distress to a firm that may arise when employees believe it is highly likely that the firm will declare bankruptcy.

16.20 **The costs of debt:** Santa's Shoes is a retailer that has just begun having financial difficulty. Santa's suppliers are aware of the increased possibility of bankruptcy. What might Santa's suppliers do based on this information?

16.21 **Stockholder–manager agency costs:** Deficit Corp. management has determined that the firm will be $50 million short of being able to pay its debt obligations at the end of this year. Management has identified a positive NPV project that will require a great deal of effort on its part. However, this project is expected to generate only $40 million at the end of the year. Assume that all the members of Deficit's management team will lose their jobs if the firm goes into bankruptcy at the end of the year. How likely is management to take the positive NPV project? If management declines the project, what kind of cost will Deficit's stockholders incur?

16.22 **Two theories of capital structure:** Use the information in the following table to make a suggestion concerning the proportion of debt that the firm should utilize in its capital structure.

Benefit or (Cost)	No Debt	25% Debt	50% Debt	75% Debt
Tax shield	$ 0	$10	$20	$30
Agency cost	−$10	−$ 5	−$ 5	−$20
Financial distress cost	−$ 1	−$ 3	−$10	−$10

16.23 **Two theories of capital structure:** Problem 16.22 introduces taxes and information and transaction costs to the simplified Modigliani and Miller model. If the marginal tax rate for the firm were to suddenly increase by a material amount, would the capital structure that maximizes the firm include less or more debt?

16.24 **Two theories of capital structure:** Describe how managers who subscribe to the pecking order theory of financing would rank the alternative sources of financing. Evaluate that ranking in terms of the costs of each source relative to the costs of other sources.

16.25 **Two theories of capital structure:** The pecking order theory suggests that managers prefer to first use internally generated equity to finance new projects. Does this preference mean that these funds represent an even cheaper source of funds than debt? Justify your answer.

16.26 **The costs of debt:** Discuss how the legal costs of financial distress may increase with the probability that a firm will formally declare bankruptcy, even if the firm has not reached that point yet.

Advanced

16.27 Operating a firm without debt is generally considered to be a conservative practice. Discuss how such a conservative approach to a firm's capital structure is good or bad for the value of the firm in the absence of information or transaction costs and any effect of debt on the real investment policy of the firm.

16.28 Finite Corp. has $250 million of debt outstanding at an interest rate of 11 percent. What is the present value of the debt tax shield if the debt will mature in five years (and no new debt will replace the old debt), assuming that Finite is subject to a 40 percent marginal tax rate?

16.29 The Boring Corporation is currently valued at $900 million, but management wants to completely pay off its perpetual debt of $300 million. Boring is subject to a 30 percent marginal tax rate. If Boring pays off its debt, what will the total value of its equity be?

16.30 If we drop the assumption that there are no information or transaction costs, in addition to dropping the no-tax assumption, then will the Modigliani and Miller model still suggest that the firm should take on a greater proportion of debt in its capital structure? Explain.

16.31 PolyAna Corporation has such high cash flow that the company's managers take Fridays off for a weekly luncheon in Cancun using the corporate jet. Describe how altering the capital structure of the firm might make the management of this firm stay in the office on Fridays in order to work on new positive NPV projects.

16.32 **M&M Proposition 2 with taxes:** Forwards Resources Company is currently an all-equity firm with a WACC of 14 percent and a 40 percent marginal tax rate. Forwards wants to move to a capital structure with $250 million of debt outstanding at an interest rate of 9 percent and a market value of equity equal to $750 million outstanding. Using M&M Proposition 2 with taxes, Equation 16.5, what is the expected return on equity at the new capital structure?

16.33 **M&M Proposition 2 with taxes:** You own all of the equity in a debt-free app development business that generates cash flows of $400,000 each year in perpetuity. The cost of assets, k_{Assets}, is 10 percent and the tax rate is 25 percent. What is the value of your all-equity firm? If you decide to replace $1 million of equity by borrowing $1 million at an interest rate of 6 percent, how much would the value of the firm increase? What would the k_{cs} and WACC for your business be before and after the proposed financial restructuring? Use M&M Proposition 2 with taxes, Equation 16.5, to determine the expected return on the equity for input to the WACC calculation. Assume that all cash flows are perpetuities and that the second and third M&M conditions hold.

CFA Problems

16.34 Consider two companies that operate in the same line of business and have the same degree of operating leverage: the Basic Company and the Grundlegend Company. The Basic Company has no debt in its capital structure, but the Grundlegend Company has a capital structure that consists of 50 percent debt. Which of the following statements is true?

- **a.** The Grundlegend Company has a degree of total leverage that exceeds that of the Basic Company by 50 percent.
- **b.** The Grundlegend Company has the same sensitivity of net earnings to changes in earnings before interest and taxes as the Basic Company.
- **c.** The Grundlegend Company has the same sensitivity of earnings before interest and taxes to changes in sales as the Basic Company.
- **d.** The Grundlegend Company has the same sensitivity of net earnings to changes in sales as the Basic Company.

16.35 According to the pecking order theory:

- **a.** New debt is preferable to new equity.
- **b.** New equity is preferable to internally generated funds.
- **c.** New debt is preferable to internally generated funds.
- **d.** New equity is always preferable to other sources of capital.

16.36 According to the trade-off theory:

- **a.** The amount of debt a company has is irrelevant.
- **b.** Debt should be used only as a last resort.
- **c.** Debt will not be used if a company's tax rate is high.
- **d.** Companies have an optimal level of debt.

Sample Test Problems

16.1 Central Grocers Inc. produces annual cash flows of $175,000, which are expected to continue indefinitely. The company is financed entirely with equity capital at an annual cost of 12 percent. Management is considering borrowing $400,000 at an annual interest rate of 6 percent to repurchase $400,000 of the company's outstanding stock. (You can assume that the debt will be outstanding into the indefinite future.) What is the total value of Central Grocers' stock before the stock repurchase? Under the assumptions in Modigliani and Miller's Proposition 1, what would be the value of the total claims on the company's assets after the stock repurchase? What will be the rate of return on common stock required by investors after the repurchase?

16.2 The required rate of return on the assets of a firm is 12 percent. The firm has a debt-to-common-stock ratio of 40 percent and a cost of debt of 6 percent. If the firm has no preferred stock and the three conditions specified by M&M hold, what is the expected rate of return on the firm's common stock?

16.3 Your boss at Box and Freight Company asks you how much additional debt the company would have to add through a capital restructuring in order to create $9 million in present value from the resulting interest tax shields. What would you tell your boss if the debt will have no maturity and if Box and Freight is subject to a 32 percent marginal tax rate?

16.4 Southwest Airlines has substantial cash reserves and an investment-grade bond rating. How would the trade-off theory predict that managers of Southwest would raise capital and choose the company's capital structure if they were planning an expansion into Mexico? What would the pecking order theory suggest?

16.5 What control implications do a firm's capital structure decisions have?

Figure A16.1

Value component	Value		
	Year 0	Year 10	Year 20
Pfizer-specific	$10 mil	$ 5 mil	$ 0 mil
General	$40 mil	$20 mil	$ 0 mil

EXHIBIT A16.1 **NPV of the Cash Flows for Leasing the Wood Lathe**

This table shows the cash flows and the NPV of the cash flows associated with leasing the wood lathe. This analysis excludes cash flows that would be the same under both the purchase and lease alternatives.

Year	Pre-Tax Lease Payment (1)	After-Tax Lease Payment (1) × (1 − 0.25) (2)
1	−$3,400	−$2,550
2	−$3,400	−$2,550
3	−$3,400	−$2,550
4	−$3,400	−$2,550
5	−$3,400	−$2,550
6	−$3,400	−$2,550
After-tax cost of debt = 0.08 × (1 − 0.25) = 0.06, or 6%		
NPV of total after-tax cash flows at 6 percent = −$12,539.18		

DECISION MAKING

EXAMPLE A16.1 | Lease or Purchase Decision

Situation You work for a courier firm that offers fast physical delivery of packages in downtown New York City (Manhattan). If someone wants to have a package delivered before the postal service or one of the big courier firms, such as FedEx or UPS, can deliver it, he or she will call your office and you will send a courier on a bicycle to pick up the package and make the delivery. Your couriers have used their own bicycles up to this point, but you have decided that it conveys a more professional image if they use identical bicycles with your company's logo on them. A bicycle manufacturing company has offered to lease or sell you the bicycles that you want. After performing an NPV analysis, you find that the NPV associated with leasing a bicycle for two years is −$545.12 and that the NPV associated with purchasing and maintaining the same bicycle is −$515.00. Should you purchase or lease the bicycles?

Decision The NPV analysis suggests that you should purchase the bicycles because it is less expensive to purchase them than to lease them. Of course, this assumes that all the relevant costs are reflected in your analysis.

EXHIBIT A16.2 **NPV of the Cash Flows for Purchasing the Wood Lathe**

This table shows the cash flows and the NPV of the cash flows associated with purchasing the wood lathe. This analysis excludes cash flows that would be the same under both the purchase and lease alternatives.

	Loan			Depreciation					
		Interest							Total
Year	Principal Repayment (1)	Pre-Tax (8% × $20,000) (2)	After-Tax (2) × (1 − 0.25) (3)	Percent of Asset Cost (4)	Depreciation Deduction (4) × $20,000) (5)	Tax Savings (5) × 0.25 (6)	After-Tax Maintenance Cost $500 × (1 − 0.25) (7)	After-Tax Salvage value[a] $10,000 × (1 − 0.25) (8)	After-Tax Cash Flows (1) + (3) + (6) + (7) +(8) (9)
1		−$1,600	−$1,200	20.00%	$4,000	$800.00	−$375		−$775
2		−$1,600	−$1,200	32.00%	$6,400	$2,048.00	−$375		$473
3		−$1,600	−$1,200	19.20%	$3,840	$737.28	−$375		−$838
4		−$1,600	−$1,200	11.52%	$2,304	$265.42	−$375		−$1,310
5		−$1,600	−$1,200	11.52%	$2,304	$265.42	−$375		−$1,310
6	−$20,000	−$1,600	−$1,200	5.76%	$1,152	$66.36	−$375	$7,500	−$14,009
After-tax cost of debt = 0.08 × (1 − 0.25) = 0.06, or 6%									
NPV of total after-tax cash flows at 6 percent = −$12,904.97									

[a]Since the lathe will be fully depreciated at the end of the sixth year, the entire salvage value will be taxable.

Self-Study Problem

A16.1 You own a real estate investment firm and have been asked by the owner of Big Box Shipping Company if you would be willing to construct an office building and lease it to Big Box. The owner of Big Box has some very unusual requirements for the interior layout of the building and is only willing to commit to leasing the building for 10 years, even though the life of the building is likely to be many times that long. What should concern you about this proposal?

Solution to Self-Study Problem

A16.1 Assuming that there is likely to be sufficient demand for office space in the same area by other businesses at the end of the 10 years, the biggest concern would be the interior layout requirements. If the owner of Big Box wants permanent interior walls for this layout and future potential tenants are likely to demand costly changes, this building would be a firm-specific asset and might not be a good investment for you. You should consider making the investment only if the lease payments include the cost of reconfiguring the space when Big Box moves out. Avoiding this sort of problem is a major reason that modern office buildings are often built without permanent interior walls and tenants use moveable cubicles instead.

Discussion Questions

A16.1 Your boss just read an article about the tax benefits of leasing. He states that your firm should lease all of its assets since it faces a low tax rate. How would you respond?

A16.2 You have decided to open a Segway Personal Transporter (PT) rental shop on your campus. A Segway PT is a two-wheeled electric personal transportation system that enables a person to move around more efficiently in urban settings. If you plan to rent Segway PTs by the day, what sort of asset abuse problem(s) are you likely to be concerned about and how might you control it/them?

Questions and Problems

Basic

A16.1 **Leasing:** What characteristic of a lease leads to conflicts between the lessee and the lessor?

Intermediate

A16.2 **Leasing:** Fresno Machine Shop management has decided to acquire a new machine that costs $3,000. The machine will be worthless after three years. Only straight-line depreciation is allowed by the IRS for this type of machine. ABC Leasing, Inc., offers to lease the same machine to Fresno under an operating lease. Annual lease payments are $1,200 per year and are due at the end of each of the three years. The market-wide borrowing rate is 8 percent for loans on assets such as this. Fresno's marginal tax rate is 35 percent. Should Fresno lease the machine or buy it? Assume that Fresno would not borrow to purchase the machine.

Advanced

A16.3 Your firm is considering leasing a Chrome® computer. The lease would last for three years and require four payments of $100 per year, with the first payment due immediately. The computer would cost $360 to buy and would be depreciated using straight-line depreciation over three years to a salvage value of zero. The actual salvage value is expected to be $100 after three years. The borrowing rate is 10 percent for loans on assets such as this, and your firm's marginal tax rate is 25 percent. Should your firm lease or buy the computer?

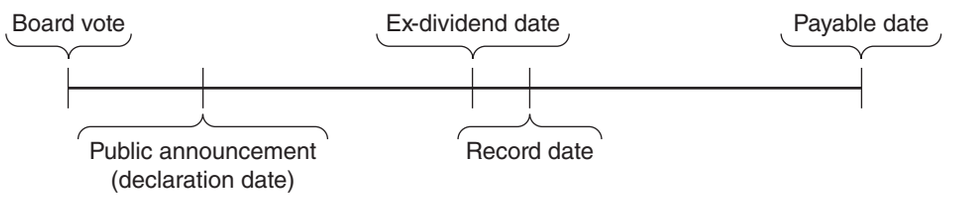


EXHIBIT 17.1 **The Dividend Payment Process Time Line for a Public Company**

The dividend payment process begins when the board votes to pay a dividend. Shortly afterward, the firm publicly announces its intent to pay a dividend, along with, typically, the amount of the dividend, the ex-dividend date, and the record date. The record date is the date by which an investor must be a stockholder of record in order to receive the dividend. The ex-dividend date, which is set by the stock exchange, normally precedes the record date by two days and is the date before which an investor must buy the stock to be a stockholder of record on the record date. The payable date is the date on which the firm actually pays the dividend.

LEARNING BY DOING

APPLICATION 17.1 | Stock Prices and Dividend Payments

Problem It is January 20, 2018, and J&W Corporation's stock is trading at $23.50 per share. Earlier today, J&W announced that the record date for its next regular cash dividend will be Wednesday, February 15, 2018, and that the dividend payment will be $0.40 per share. The stock exchange has just announced that the ex-dividend date will be Monday, February 13, 2018. If all investors pay taxes of 20 percent on dividends (this became the top rate for all but the highest earners in 2013), what do you expect to happen to J&W's stock price between the time the market closes on Friday, February 10, 2018, and the time it opens on Monday, February 13, 2018?

Approach The stock price should decline by an amount that equals the after-tax value of the dividend; you can therefore answer this question by calculating this after-tax value.

Solution You would expect the price of J&W's stock to decrease by $\$0.40 \times (1 - 0.20) = \$0.32$. You cannot say what the actual stock price will be after this decrease because you do not know what the price will be beforehand. The $23.50 price is for January 20, 2018, not for February 10, 2018, the day immediately before the ex-dividend date.

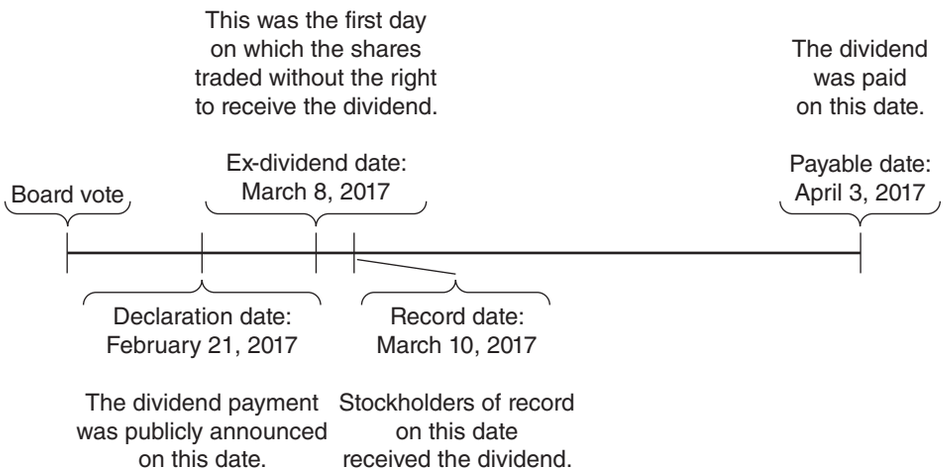


EXHIBIT 17.2 **Key Dates for Wal-Mart's First Quarter 2017 Dividend**

This exhibit summarizes the key dates and time line for the regular cash dividend that Wal-Mart paid on April 3, 2017.

LEARNING BY DOING

APPLICATION 17.2 | Stock Repurchases and Taxes

Problem Your pizza parlor business has been doing very well, and, as a result, you have more cash than you can productively reinvest in the business. You have decided to distribute this cash to yourself, the only stockholder, through a stock repurchase. When you started the business, you invested $300,000 and received 10,000 shares of stock. In other words, each share cost you $30. There are no other shares outstanding, and your business valuation adviser tells you that the stock is worth $800,000 today. If you want to distribute $80,000 through a stock repurchase, how many shares will the company have to repurchase? If you pay taxes of 20 percent on capital gains, how much money will you have left over after paying taxes on the proceeds from the sale of your stock?

Approach First calculate the current share price. Next, divide the amount of cash that you want to distribute by the share price to obtain the number of shares the company will have to repurchase. To calculate the amount of money you would have left over after paying taxes, first compute the capital gain (profit) per share on the stock and multiply this amount by the tax rate and the number of shares the company will have to repurchase to obtain the total tax. Then, subtract the total tax from $80,000 to obtain the answer.

Solution Each share of stock is worth $80 ($800,000/10,000 shares = $80 per share) today. This means that the company would have to repurchase 1,000 shares ($80,000/$80 per share = 1,000 shares) in order to distribute $80,000.

The capital gain per share from the sale would be $50 ($80 − $30 = $50). With a 20 percent tax rate, you would pay taxes of $10,000 ($50 × 0.20 × 1,000 shares = $10,000) on the capital gain, leaving you with gross proceeds from the sale of $70,000 ($80,000 − $10,000 = $70,000).

EXHIBIT 17.3 **Descriptive Statistics for Stock Repurchases in the United States, 1984–2001**

Open-market repurchase programs are the most common means of repurchasing shares. However, managers tend to use other methods when they want to repurchase a large percentage of their firm's total shares.

	Open-Market Repurchase Programs	Fixed-Price Tender Offers	Dutch Auction Tender Offers	Targeted Stock Repurchases
Average percentage of shares repurchased	7.37%	29.46%	15.88%	13.00%
Average premium paid over market price	NA	20.74%	14.72%	1.92%
Percentage of cases where repurchase price was below market price	NA	0.00%	0.40%	44.78%
Average market-adjusted stock price change following repurchase announcement	2.39%	7.68%	7.60%	−1.81%
Number of observations	6,470	303	251	737

Source: Information from *Journal of Financial Economics*, 75(2), Urs C. Peyer and Theo Vermaelen, "The Many Facets of Privately Negotiated Stock Repurchases," 361–395, Copyright 2005, with permission from Elsevier.

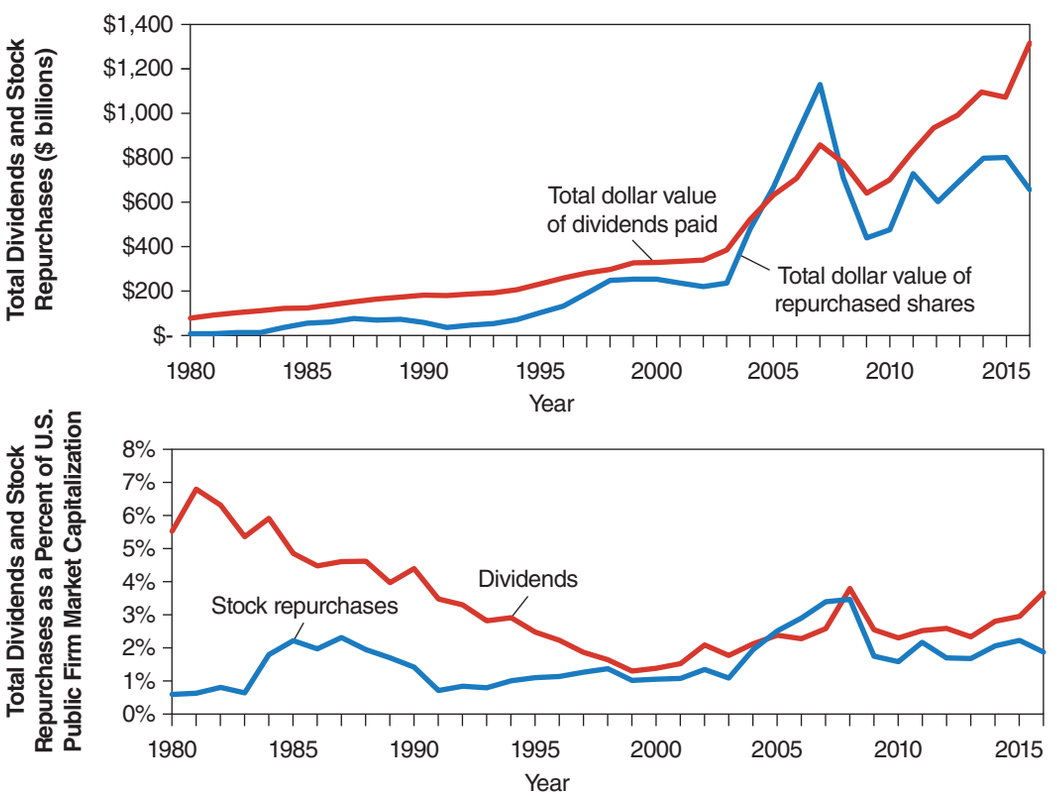


EXHIBIT 17.4 **Dividend Payments and Stock Repurchases by U.S. Public Firms, 1980–2016**

Both the dollar value of dividends paid by U.S. public firms and the dollar value of stock repurchases increased over the period from 1980 to 2016, as shown in the top figure. However, the increase was more pronounced for stock repurchases. Despite these increases in dollar values, total distributions of value as a percentage of the total market capitalization (total equity value) of U.S. firms actually decreased, as shown in the bottom figure.

Source: Estimated by authors using data from the Standard and Poors' Compustat database.

DECISION MAKING

EXAMPLE 17.1 | Choosing a Payout Method

Situation You are the chief executive officer of San Marcos Pharmaceuticals, a generic drug manufacturing firm. With patents on a lot of brand-name drugs sold by other pharmaceutical firms expiring, San Marcos has been doing very well manufacturing generic copies of those drugs. In fact, business has been going so well that San Marcos is generating more cash flow than is required for investment in the positive NPV projects that are available to the company.

You have decided that you want to distribute the excess (free) cash flow to stockholders rather than accumulate it in the company's cash accounts. You expect the company to continue to generate free cash flow in the future, but the amount is likely to vary considerably as the new national health law goes into effect. You want to be able to adjust distributions as free cash flows rise and fall but do not want to make San Marcos's stock price any more volatile than it already is. Furthermore, relatively few of the company's shares are held by investors that do not pay taxes, such as pension funds and university endowments, so you would prefer that the distributions be as tax efficient as possible.

Your chief financial officer tells you that the most feasible means of distributing the excess cash on an ongoing basis is to pay a regular cash dividend or to repurchase shares through open-market repurchases. Which of these two options should you choose?

Decision As long as the ownership structure of the company or the liquidity of its shares is not severely altered or impaired, the open-market repurchase alternative is the better choice. Open-market repurchases can easily be adjusted to accommodate changes in the amount of free cash flow that San Marcos generates without adding to stock price volatility. In contrast, increasing and decreasing a regular cash dividend as free cash flows rise and fall would most likely add to the volatility of the company's stock price. Since an open-market repurchase program is more tax efficient than a regular cash dividend, it will also enable stockholders to keep more of the money that is distributed to them. Finally, it will let individual stockholders choose whether they want to participate in the program in the first place.

Self-Study Problems

17.1 You would like to own a common stock that has a record date of Friday, September 8, 2017. What is the last date that you can purchase the stock and still receive the dividend?

17.2 You believe that the average investor is subject to a 20 percent tax rate on dividend payments. If a firm is going to pay a $0.30 dividend, by what amount would you expect the stock price to drop on the ex-dividend date?

17.3 Management of the Veil Acts Company just announced that instead of a regular dividend this quarter, the company will repurchase shares using the same amount of cash that would have been paid in the suspended dividend. Should this be a positive or negative signal from the firm?

17.4 Management of the Bernie Rubbel Company has just declared a three-for-one stock split. If you own 12,000 shares before the split, how many shares will you own after the split? What if it were a one-for-three reverse stock split?

17.5 Two publicly traded companies in the same industry are similar in all respects except one. Whereas Publicks has issued debt in the public markets, Privicks has never borrowed from any public source. In fact, Privicks always uses private bank debt for its borrowing. Which firm is likely to have a more aggressive regular dividend payout? Explain.

Solutions to Self-Study Problems

17.1 The ex-dividend date is the first day that the stock will be trading without the rights to the dividend, and that occurs two days before the record date, or on Wednesday, September 6, 2017. Therefore, the last day that you can purchase the stock and still receive the dividend will be the day before the ex-dividend date, or Tuesday, September 5, 2017.

17.2 If the tax rate of the average investor is reflected in the stock price change, we would expect investors to receive 80 percent (1.0 − 0.20 = 0.80, or 80 percent) of the dividend after paying taxes. This implies a $0.24 (0.80 × $0.30 = $0.24) drop in the stock price of the firm on the ex-dividend date.

17.3 Veiled Acts has replaced a commitment to distribute cash with a stated intention to distribute cash that does not have to be acted on. The signal would be negative if the announcement was interpreted to suggest that management is concerned about the level of cash flows from operations this quarter.

17.4 You will own three shares of Bernie Rubbel for every one share that you currently own. Therefore, you will own 3 × 12,000 shares = 36,000 shares of the company. In the case of the reverse split, you will own 1/3 × 12,000 shares = 4,000 shares of the company.

17.5 If all other characteristics of the two companies are the same, then Publicks could be expected to have a more aggressive dividend payout. Since Publicks has issued debt in the past, while Privicks has not, Publicks is likely to have greater access to the capital markets than Privicks. Firms with greater access to capital markets can be more aggressive in their dividend payouts to the extent that they can raise capital more easily (cheaply) if necessary.

Discussion Questions

17.1 Suppose that you live in a country where it takes 10 days to settle a stock purchase. By how many days will the ex-dividend date precede the record date?

17.2 The price of a share of stock is $15.00 on Tuesday, November 14, 2017. The record date for a $0.50 dividend is Friday, November 17, 2017. If there are no taxes on dividends, what would you expect the price of a share to be on each day from November 14 through 17 if no other information relevant to the price of the shares becomes public?

17.3 You find that you are the only investor in a particular stock who is subject to a 15 percent tax rate on dividends (all other investors are subject to a 5 percent tax rate on dividends). Is there greater value to you in holding the stock beyond the ex-dividend date or selling the stock and then repurchasing it on or after the ex-dividend date? Assume that the stock is currently selling for $10.00 per share and the dividend will be $0.25 per share.

17.4 Discuss why the dividend payment process is so much simpler for private companies than for public companies.

17.5 You are the CEO of a firm that appears to be the target of a hostile takeover attempt. Thibeaux Piques has been accumulating the shares of your stock and now holds a substantial percentage of the outstanding shares. You would like to purchase the shares that he owns. What method of stock repurchase will you choose?

17.6 You have accumulated stock in a firm that does not pay cash dividends. You have read that, according to Modigliani and Miller, you can create a "homemade" dividend should you require cash. Discuss why this choice may not be very good for the overall value of your position.

17.7 You have just read a press release in which a firm claims that it will be able to generate a higher level of cash flows for its investors going forward. Justify the choice of a dividend payout that could credibly convey that information to the market.

17.8 Some people argue that a high tax rate on dividends creates incentives for managers to go about their business without credibly convincing investors that the firm is doing well, even when it is. Discuss why this may be true.

17.9 Fred Flightstone Mining Co. management does not like to pay cash dividends due to the volatility of the company's cash flows. Management has found, however, that when the company does not pay dividends, its stock price becomes too high for individual investors to afford round lots. What course of action could management take to get the stock price down without dissipating firm value for stockholders?

17.10 The Lintner study found that firms are reluctant to make dividend changes that might have to be reversed. Discuss the rationale for that behavior.

Questions and Problems

Basic

17.1 **Dividends:** The Poseidon Shipping Company has paid a $0.25 dividend per quarter for the past three years. Poseidon just lowered its declared dividend to $0.20 for the next dividend payment. Discuss what this new information might convey concerning Poseidon management's belief about the future of the company.

17.2 **Dividends:** Marx Political Consultants management has decided to discontinue all of the firm's business operations. The firm has total debt of $7 million, and the liquidation value of its assets is $10 million. If the book value of the firm's equity is $5 million, then what will be the amount of the liquidating dividend when the firm liquidates all of its assets?

17.3 **Dividends:** Place the following in the proper chronological order, and describe the purpose of each: ex-dividend date, record date, payment date, and declaration date.

17.4 **Dividends and firm value:** Explain how the issuance of new securities by a firm can produce useful information about the issuing

firm. How can this information make the shares of the firm more valuable, even if it only confirms existing information about the firm?

17.5 Dividends: Explain why holders of a firm's debt should insist on a covenant that restricts the amount of cash dividends the firm pays.

17.6 Stock splits and stock dividends: Explain why managers of firms might prefer that their firms' shares trade in a moderate per-share price range rather than in a high per-share price range. How do managers of firms keep their shares trading in a moderate price range?

17.7 Dividends: Scintilla, Inc., stock is trading for $10.00 per share on the day before the ex-dividend date. If the dividend is $0.25 and there are no taxes, what should the price of the shares be on the ex-dividend date?

17.8 Dividends: A company's management announces a $1.00 per share dividend payment. Assuming all investors are subject to a 15 percent tax rate on dividends, how much should the company's share price drop on the ex-dividend date?

Intermediate

17.9 Dividends and firm value: Explain how a stock repurchase is different from a dividend payment.

17.10 Dividends and firm value: You have just encountered two identical firms with identical investment opportunities, as well as the ability to fund these opportunities. One of the firms has just announced that it will pay a dividend, while the other has continued to pay no dividend. Which of the two firms is worth more? Explain.

17.11 Dividends and firm value: Explain what the introduction of transaction costs does to the Modigliani and Miller assumption that dividends are irrelevant. Start with a firm that pays dividends to investors that do not want to receive dividend payments. Do not consider taxes.

17.12 Dividends and firm value: CashCo increased its cash dividend each quarter for the past eight quarters. While this may signal that the firm is financially very healthy, what else could we conclude from these actions?

17.13 Dividends and firm value: In 2013 the maximum tax rate on dividends increased from 15 percent to 23.8 percent. How would you expect this increase to affect the prices of dividend-paying stocks versus those of nondividend-paying stocks?

17.14 Dividends: Undecided Corp. has excess cash on hand right now, although management is not sure about the level of cash flows going forward. If management would like to put cash in stockholders' hands, what kind of dividend should the firm pay, and why?

17.15 Dividends and firm value: A firm can deliver a negative signal to stockholders by increasing the level of dividends or by reducing the level of dividends. Explain why this is true.

17.16 Dividends and firm value: A commentator on a financial talk show on TV says that "On average, firms pay out too little to stockholders. This is why stock prices go up with dividend increases and down with dividend decreases." Is the commentator right?

17.17 Dividends and firm value: You own shares in a firm that has extra cash on hand to distribute to stockholders. You do not want the cash. What course of action would you prefer the firm take?

17.18 Dividends and firm value: Stock repurchases, once announced, do not actually have to occur in total or in part. From a signaling perspective, why would a special dividend be better than a stock repurchase?

17.19 Dividends and firm value: Consider a firm that repurchases shares from its stockholders in the open market, and explain why this action might be detrimental to the stockholders from whom the firm buys shares.

17.20 Dividends and firm value: You read that a number of public companies have been financing their dividend payments in recent years entirely through equity issues. A colleague of yours argues that this only increases taxes paid by individual stockholders and boosts underwriting and other transactions costs for the company. He says that such a policy cannot make sense. What do you say?

17.21 Stock repurchases: Briefly discuss the methods available for a firm to repurchase its shares and explain why you might expect the stock price reaction to the announcement of each of these methods to differ.

17.22 Stock repurchases: What is an advantage of a Dutch auction over a fixed-price tender offer?

Advanced

17.23 In the early 1990s, the amount of time that elapsed between purchasing a stock and actually obtaining that stock was five business days. This period was known as the settlement period. The settlement period for stock purchases is now two business days. Describe what should have happened to the number of days between the ex-dividend date and the record date at the time of this change.

17.24 Dividend reinvestment programs (DRIPs) sometimes sell shares at a discount to stockholders who reinvest their dividends through such plans. Your boss tells you that such plans are just a scheme to transfer wealth from nonparticipating to participating stockholders and that they should be stopped. Do you agree? Why or why not?

17.25 WeAreProfits, Inc., has not issued any new debt securities in 10 years. It will begin paying cash dividends to its stockholders for the first time next year. Explain how a dividend might help the firm get closer to its optimal capital structure of 50 percent debt and 50 percent equity.

17.26 Shadows, Inc., had shares outstanding that were valued at $120 per share before a two-for-one stock split. After the stock split, the shares were valued at $62 per share. If we accept that the firm's financial maneuver did not create any new value, then why might the market value of the shares increase?

17.27 Saguaro Company currently has 30,000 shares outstanding. Each share has a market value of $20. If the firm pays $5 per share in

dividends, what will each share be worth after the dividend payment? Ignore taxes.

17.28 Cholla Company currently has 30,000 shares outstanding. Each share has a market value of $20. If the firm repurchases $150,000 worth of shares, then what will be the value of each share outstanding after the repurchase? Ignore taxes.

17.29 You purchased 1,000 shares of Koogal stock five years ago for $30 per share. Today Koogal is repurchasing your shares through a fixed-price tender offer for $80 per share. What are the after-tax proceeds to you if only your capital gain is taxed at a 15 percent rate?

17.30 You purchased 1,000 shares of Zebulon Copper Co. five years ago for $50 per share. Today Zebulon management is trying to decide whether to repurchase shares for $70 per share through a fixed-price tender offer or pay a $70 cash dividend per share. If capital gains are taxed at a 15 percent rate, then at what rate must dividends be taxed for you to be indifferent between receiving the dividend and selling your shares back to Zebulon?

17.31 Llama Wool Company management is doing some financial planning for the coming year. Llama plans to raise $10,000 in new equity this year and wants to pay a dividend to stockholders of $30,000. The firm must pay $20,000 of interest during the year and will also pay down principal on its debt obligations by $10,000. Its capital budgeting plan calls for $100,000 of capital expenditures during the year. Given the above information, how much cash must be provided from operations for the firm to meet its plan?

17.32 You are the chief financial officer (CFO) of a large publicly traded company. You would like to convey positive information about the firm to the market. If you agree with the conclusions from the Lintner study, will you keep paying your currently high dividend or raise that dividend by a small amount? Explain.

17.33 You are the CFO of a public company that advises distressed companies about how to manage their businesses. Your company has been performing extremely well. In fact, it has earned so much money that the increase in its retained earnings has resulted in a decline in the firm's debt to total capital ratio from 30 percent to 15 percent. Much of the retained earnings is sitting in a cash account because your firm does not need the money to fund investments. You would like to increase the debt-to-total capital ratio to 30 percent, which you view as optimal for your firm. How would you recommend doing this if you want to complete the adjustment as soon as possible?

Sample Test Problems

17.1 Shares of Convoy West, Inc. are trading for $55.45 on the day before the ex-dividend date. If the quarterly dividend is $0.16 per share and there are no taxes, how will the share price change on the ex-dividend date?

17.2 Three years ago, you purchased 4,000 shares of Metwa Inc. for $17 per share. Today Metwa is repurchasing its shares through a fixed-price tender offer at a price of $45 per share. What are the after-tax proceeds that you will receive if capital gains are taxed at a rate of 20 percent?

17.3 Why does an ongoing stock repurchase program offer management greater flexibility in distributing value to stockholders than a regular cash dividend?

17.4 Why would management of a company undertake a reverse stock split?

17.5 Mastercard, Inc., completed a ten-for-one stock split on January 22, 2014. Immediately before the stock split there were 120.38 million shares outstanding at a price of $826.00 per share. After the split how many shares were outstanding, and at what price would you expect them trade? Did the stock split cause any substantial change for Mastercard or the investors? Why would Mastercard management choose to split the company's stock?

EXHIBIT 18.1 **Characteristics of Different Forms of Business Organization**

Choosing the appropriate form of business organization is an important step in starting a business. This exhibit compares key characteristics of the most popular forms of business organization in the United States.

	Sole Proprietorship	Partnership		Corporation		Limited Liability Partnership (LLP) or Company (LLC)
		General	Limited	S-Corp.	C-Corp.	
Cost to establish	Inexpensive	More costly	More costly	More costly	More costly	More costly
Life of entity	Limited	Flexible	Flexible	Indefinite	Indefinite	Flexible
Control by founder over business decisions	Complete	Shared	Shared	Depends on ownership	Depends on ownership	Shared
Access to capital	Very limited	Limited	Less limited	Less limited	Excellent	Less limited
Cost to transfer ownership	High	High	High	High	Can be low	High
Separation of management and investment	No	No	Yes	Yes	Yes	Yes
Potential owner/ manager conflicts	No	No	Some	Potentially high	Potentially high	Some
Ability to provide incentives to attract and retain high-quality employees	Limited	Good	Good	Good	Good	Good
Liability of owners	Unlimited	Unlimited	Unlimited for general partner	Limited	Limited	Limited
Tax treatment of income	Flow-through	Flow-through	Flow-through	Flow-through	Double tax	As elected
Tax deductibility of owner benefits	Limited	Limited	Limited	Limited	Limited	Limited

EXHIBIT 18.2 **Pizza Palace Monthly Cash Budget for the Period March 2018 through February 2019[a]**

A monthly cash budget summarizes the cash that management expects to flow into and out of a business each month. At a minimum, it presents the cash inflows and outflows for each of the next 12 months and for the entire 12-month period. Monthly cash budgets can extend beyond 12 months.

Row	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Total
1. **Beginning cash balance**	$75,000	$ 6,097	$ 5,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000	$ 6,497	$ 7,993	$ 9,490	$10,987	$12,483	
2. **Cash receipts:**													
3. Cash sales	3,000	12,000	15,000	20,000	25,000	30,000	35,000	35,000	35,000	35,000	35,000	35,000	$315,000
4. Collections from credit accounts	–	–	–	–	–	–	–	–	–	–	–	–	–
5. Investments by owner	–	9,457	9,103	6,553	4,004	1,253	–	–	–	–	–	353	30,723
6. Total cash receipts	$ 3,000	$21,457	$24,103	$26,553	$29,004	$31,253	$35,000	$35,000	$35,000	$35,000	$35,000	$35,353	$345,723
7. **Total cash available**	$78,000	$27,554	$29,103	$31,553	$34,004	$36,253	$40,000	$41,497	$42,993	$44,490	$45,987	$47,836	
Cash payments:													
8. Operations													
9. Food purchases	$ 1,200	$ 4,800	$ 6,000	$ 8,000	$10,000	$12,000	$14,000	$14,000	$14,000	$14,000	$14,000	$14,000	$126,000
10. Gross wages	10,800	10,800	10,800	10,800	10,800	10,800	10,800	10,800	10,800	10,800	10,800	10,800	129,600
11. Payroll expenses	1,620	1,620	1,620	1,620	1,620	1,620	1,620	1,620	1,620	1,620	1,620	1,620	19,440
12. Misc. supplies	500	500	500	500	500	500	500	500	500	500	500	500	6,000
13. Repairs and maintenance	150	600	750	1,000	1,250	1,500	1,750	1,750	1,750	1,750	1,750	1,750	15,750
14. Advertising	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	12,000
15. Accounting and legal	3,000	200	200	200	200	200	200	200	200	200	200	200	5,200
16. Rent	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	18,000
17. Telephone and utilities	1,000	1,200	1,400	1,600	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	19,600
18. Other expenses	–	–	–	–	–	–	–	–	–	–	–	–	–
19. Operations total	$20,770	$22,220	$23,770	$26,220	$28,670	$30,920	$33,170	$33,170	$33,170	$33,170	$33,170	$33,170	$351,590
Financing and investments:													
20. Interest payments	$ 333	$ 333	$ 333	$ 333	$ 333	$ 333	$ 333	$ 333	$ 333	$ 333	$ 333	$ 333	$ 4,000
21. Principal payments on loans	–	–	–	–	–	–	–	–	–	–	–	10,000	10,000
22. Capital expenditures	50,000	–	–	–	–	–	–	–	–	–	–	–	50,000
23. Start–up costs	800	–	–	–	–	–	–	–	–	–	–	–	800
24. Withdrawals by owner	–	–	–	–	–	–	–	–	–	–	–	–	–
25. Total cash payments	$71,903	$22,553	$24,103	$26,553	$29,003	$31,253	$33,503	$33,503	$33,503	$33,503	$33,503	$43,503	$416,390
26. **Ending cash balance**	$ 6,097	$ 5,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000	$ 6,497	$ 7,993	$ 9,490	$10,987	$12,483	$ 4,333	

[a]Some totals do not appear to add up precisely because the actual values computed in the model are rounded to the nearest whole number for presentation in this exhibit.

EXAMPLE 18.1 | Using a Cash Budget

DECISION MAKING

Situation It is January 1, and you have prepared the following cash budget for the next four months for your new business venture:

Monthly Cash Budget

	Jan.	Feb.	Mar.	Apr.	Total
Beginning cash balance	$ 0	($ 18,510)	($ 25,270)	($ 28,530)	
Cash receipts:					
Cash sales	2,500	5,000	12,000	20,000	$39,500
Investments by owner	–	–	–	–	–
Total cash receipts	$ 2,500	$ 5,000	$ 12,000	$ 20,000	$39,500
Total cash available	$ 2,500	($ 13,510)	($ 13,270)	($ 8,530)	
Cash payments:					
Operations					
Merchandise purchases	$ 1,250	$ 2,500	$ 6,000	$ 10,000	$19,750
Gross wages and payroll	5,760	5,760	5,760	5,760	23,040
Advertising	1,000	1,000	1,000	1,000	4,000
Rent	1,500	1,500	1,500	1,500	6,000
Other expenses	1,000	1,000	1,000	1,000	4,000
Operations total	$ 10,510	$ 11,760	$ 15,260	$ 19,260	$56,790
Financing and investments					
Capital expenditures	$ 10,000	–	–	–	$10,000
Start-up costs	500	–	–	–	500
Withdrawals by owner	–	–	–	–	–
Total cash payments	$ 21,010	$ 11,760	$ 15,260	$ 19,260	$67,290
Ending cash balance	($18,510)	($25,270)	($28,530)	($27,790)	

If you plan to finance the business entirely with equity, how much money should you invest now to ensure that there is at least $1,000 still in the business at the end of April? How much will you have to invest each month after April to maintain a $1,000 cash balance if the cash inflows and outflows in the following months look like those for April?

Decision Assuming that your cash forecast is correct, you should invest $28,790 today. This will cover the $27,790 cash shortfall reflected in the ending cash balance for April while leaving $1,000 in the business. The ending cash balance for April reflects the cumulative cash shortfall over the four-month period because the beginning cash balance for January has been set to zero. You will not have to invest any money after April because the cash inflows exceed the cash outflows in April, and this is not expected to change in the following months.

APPLICATION 18.1 | Using the Adjusted Book Value Approach

LEARNING BY DOING

Problem You are considering purchasing a company that manufactures specialized components for recreational vehicles. These components are sold to the companies that manufacture the vehicles. As part of your analysis of this opportunity, you decide to estimate the liquidation value of the company. Management has provided you with the following information about its assets. All values are in thousands of dollars.

Cash	$ 444
Accounts receivable	739
Inventory	1,436
Net PP&E	8,463
Total assets	$11,082

Management has also told you that you can reasonably expect to collect 93 percent of the receivables (accounting for collection expenses), that the inventory can be sold to realize 85 percent of its book value, and that sale of the property, plant, and equipment would yield $6,100. What is the liquidation value of this company?

Approach Calculate the value that will be realized for each of the individual types assets and sum those values to obtain the liquidation value of the company.

Solution The liquidation value is:

Cash	$ 444	× 100%	=	$ 444
Accounts receivable	$ 739	× 93%	=	$ 687
Inventory	$ 1,436	× 85%	=	$1,221
Net PP&E	$ 8,463			$6,100
Total assets	$11,082			$8,452

You can expect to realize $8,452 from the liquidation of this company if there are no liquidation expenses that are not accounted for in these numbers.

Figure 18.1

$$P_0 = \frac{D_1}{k_{cs} - g}$$

Figure 18.2

$$P_0 = \frac{E_1 b}{k_{cs} - g}$$

$$\frac{P_0}{E_1} = \frac{b}{k_{cs} - g} \tag{18.1}$$

LEARNING BY DOING

APPLICATION 18.2 | Using Multiples Analysis

Problem In addition to performing the liquidation analysis in Learning by Doing Application 18.1, you have decided to estimate the enterprise value of the company that manufactures specialized components for recreational vehicles. You have collected the following information for a comparable company and for the company you are valuing:

Comparable company:	*Company you are valuing:*
Stock price = \$10.62	Value of debt = \$1.25 million
Number of shares outstanding = 9.55 million	EBITDA last year = \$2.37 million
Value of debt = \$11.67 million	Net income last year = \$0.45 million
EBITDA last year = \$10.85 million	
Net income last year = \$2.67 million	

Estimate the enterprise value of the company you are valuing using the P/E and enterprise value/EBITDA multiples.

Approach First, calculate the P/E and enterprise value/EBITDA multiples for the comparable company. Next, use these multiples to estimate the value of the company you are valuing. Multiply the P/E multiple for the comparable company by the net income of the company you are valuing to estimate the equity value. Add this equity value to the value of the debt to obtain an estimate of the enterprise value. Multiply the enterprise value/EBITDA multiple for the comparable company by the EBITDA for the company you are valuing to obtain a direct estimate of the enterprise value.

Solution The P/E and enterprise value/EBITDA multiples for the comparable company are:

$$\left(\frac{P}{E}\right)_{\text{Comparable}} = \left(\frac{\text{Stock price}}{\text{Earnings per share}}\right)_{\text{Comparable}}$$

$$= \frac{\$10.62 \text{ per share}}{\$2.67 \text{ million}/9.55 \text{ million shares}} = 38.0$$

$$\left(\frac{\text{Enterprise value}}{\text{EBITDA}}\right)_{\text{Comparable}} = \left(\frac{V_D + V_E}{\text{EBITDA}}\right)_{\text{Comparable}}$$

$$= \frac{\$11.67 \text{ million} + (\$10.62 \text{ per share} \times 9.55 \text{ million shares})}{\$10.85 \text{ million}}$$

$$= 10.42$$

Using the P/E multiple, we calculate the value of the equity as:

$$V_E = \left(\frac{P}{E}\right)_{\text{Comparable}} \times \text{Net income}_{\text{Company being valued}}$$

$$= 38.0 \times \$0.45 \text{ million}$$

$$= \$17.1 \text{ million}$$

which suggests an enterprise value of:

$$V_F = V_D + V_E = \$1.25 \text{ million} + \$17.1 \text{ million} = \$18.35 \text{ million}$$

Using the enterprise/EBITDA multiple, we estimate the enterprise value to be:

$$V_F = \left(\frac{\text{Enterprise value}}{\text{EBITDA}}\right)_{\text{Comparable}} \times \text{EBITDA}_{\text{Company being valued}}$$

$$= 10.42 \times \$2.37 \text{ million}$$

$$= \$24.70 \text{ million}$$

$$V_F = PV(FCF_T) + PV(TV_T) + NOA \tag{18.2}$$

$$V_F = \sum_{t=0}^{\infty} \frac{FCFF_t}{(1 + WACC)^t} \tag{18.3}$$

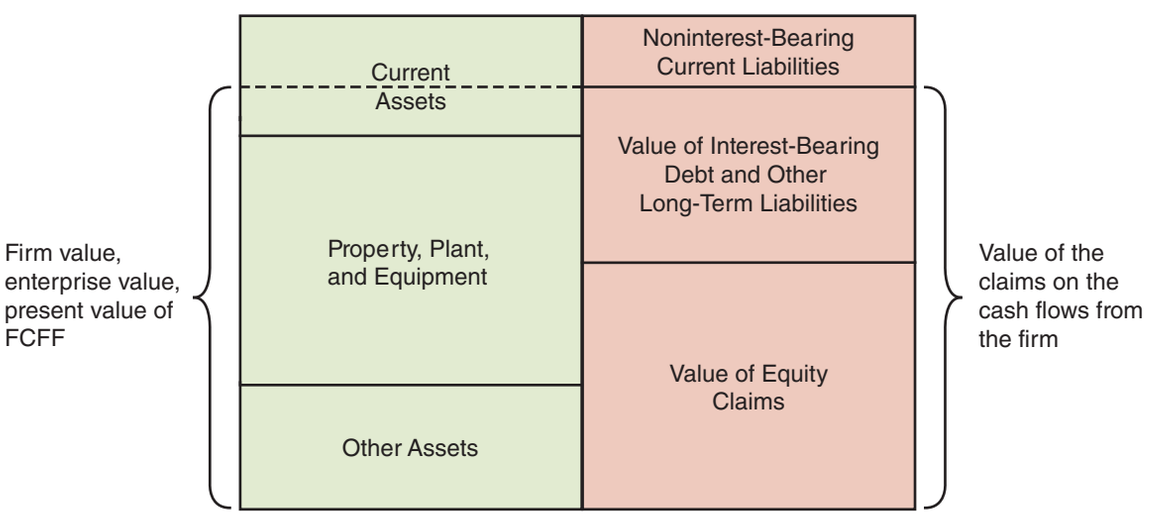


EXHIBIT 18.3 **The Finance Balance Sheet and Firm Value**

The value of a firm (enterprise value) equals the present value of the future free cash flows from the firm (FCFF). Since the owners of the interest-bearing debt and other long-term liabilities and the stockholders, collectively, have the right to receive all of the FCFF, the total value of those claims equals the value of the firm.

EXHIBIT 18.4 The FCFF Calculation

Free cash flows from the firm (FCFF) are calculated in the same way as the incremental after-tax free cash flows (FCF) that are expected from a project. The only differences between the FCFF calculation and the FCF calculation, which is illustrated in Exhibit 11.1, are that in the FCFF calculation (1) we use *total* cash flows rather than *incremental* cash flows, and (2) we use the *average* tax rate instead of the *marginal* tax rate when we are valuing a company that is operating independent of any other company.

Explanation	Calculation	Formula
The firm's cash income excluding interest expense	Revenue	Revenue
	− Cash operating expenses	− Op Ex
	Earnings before interest, taxes, depreciation and amortization	EBITDA
	− Depreciation and amortization	− D&A
	Operating profit	EBIT
	× (1 − Firm's average tax rate)	× (1 − *t*)
Adjustments for the impact of depreciation and amortization and investments on FCFF	Net operating profit after tax	NOPAT
	+ Depreciation and amortization	+ D&A
	Cash flow from operations	CF Opns
	− Capital expenditures	− Cap Exp
	− Additions to working capital	− Add WC
	= Free cash flow from the firm	= FCFE

EXHIBIT 18.5 FCFF Forecasts for Bell Mountain Manufacturing Company ($ millions)

This exhibit presents forecasts of free cash flow from the firm (FCFF) for Bell Mountain for each of the next five years.

	Year				
	1	2	3	4	5
Revenue	$100.0	$106.0	$112.4	$119.1	$126.3
− Cash operating expenses	70.0	74.2	78.7	83.4	88.4
Earnings before interest, taxes, depreciation and amortization	$ 30.0	$ 31.8	$ 33.7	$ 35.7	$ 37.9
− Depreciation and amortization	8.0	8.3	8.5	8.8	9.0
Operating profit	$ 22.0	$ 23.5	$ 25.2	$ 26.9	$ 28.9
− Taxes	7.7	8.2	8.8	9.4	10.1
Net operating profits after tax	$ 14.3	$ 15.3	$ 16.4	$ 17.5	$ 18.8
+ Depreciation and amortization	8.0	8.3	8.5	8.8	9.0
Cash flow from operations	$ 22.3	$ 23.6	$ 24.9	$ 26.3	$ 27.8
− Capital expenditures	10.0	10.0	11.0	12.0	13.0
− Additions to working capital	0.5	0.5	0.5	0.6	0.7
= Free cash flow from the firm	$ 11.8	$ 13.1	$ 13.4	$ 13.7	$ 14.1

Figure 18.3

$$V_F = PV(FCF_T) + PV(TV_T) + NOA$$
$$= \$48.45 \text{ million} + \$107.74 \text{ million} + \$14.68 \text{ million} = \$170.87 \text{ million}$$

LEARNING BY DOING

APPLICATION 18.3 | Using the FCFF Income Approach

Problem You have decided to use the FCFF income approach to estimate the intrinsic value of the company that manufactures components for recreational vehicles. You expect the company's cash flows to grow very rapidly during the next five years and to level off after that. Based on this, you forecast the cash flows for each of the next five years to be:

	Year				
	1	2	3	4	5
FCFF ($ millions)	−$0.284	$0.108	$0.998	$2.110	$2.857

You expect cash flows to be constant after Year 5. There are no NOA in this firm. If the appropriate WACC is 9 percent, what is the enterprise value of this business? What is the value of the equity if the value of the company's debt equals $1.25 million?

Approach First calculate the total present value of the individual FCFF that you have forecast by discounting them to Year 0 using the WACC and summing them up. Next, calculate the terminal value, assuming no growth in the cash flows after Year 5, and discount this value to Year 0. The enterprise value equals the present value of the individual cash flows plus the present value of the terminal value. The value of the equity can then be calculated by subtracting the value of the debt.

Solution The present value of the cash flows in the first five years is:

$$PV(FCFF_5) = \frac{-\$0.284 \text{ million}}{1 + 0.09} + \frac{\$0.108 \text{ million}}{(1 + 0.09)^2} + \frac{\$0.998 \text{ million}}{(1 + 0.09)^3}$$
$$+ \frac{\$2.110 \text{ million}}{(1 + 0.09)^4} + \frac{\$2.857 \text{ million}}{(1 + 0.09)^5}$$
$$= \$3.95 \text{ million}$$

With no growth after Year 5, the present value of the terminal value is:

$$PV(TV_5) = \frac{TV_5}{(1 + WACC)^5} = \frac{\$2.857 \text{ million}/(0.09 - 0)}{(1 + 0.09)^5} = \$20.63 \text{ million}$$

Therefore, the total enterprise value is:

$$V_F = PV(FCF_T) + PV(TV_T) + NOA = \$3.95 \text{ million} + \$20.63 \text{ million} + \$0 \text{ million}$$
$$= \$24.58 \text{ million}$$

and the value of the equity equals $24.58 million − $1.25 million = $23.33 million.

EXHIBIT 18.6 The FCFE Calculation

Free cash flow to equity (FCFE) equals free cash flow from the firm (FCFF) less any net cash outflows to debt holders. In the FCFE calculation, we subtract the interest and principal payments to the debt holders and add any proceeds from the sale of new debt.

Explanation	Calculation	Formula
The firm's cash income	Revenue	Revenue
	− Cash operating expenses	− Op Ex
	Earnings before interest, taxes, depreciation and amortization	EBITDA
	− Depreciation and amortization	− D&A
	Operating profit	EBIT
	− Interest	− Int
	Earnings before tax	EBT
	× (1 − Firm's average tax rate)	× (1 − t)
	Net income	NI
Adjustments for the impact of depreciation and amortization, investments on FCFF, and debt repayments and new issues	+ Depreciation and amortization	+ D&A
	Cash flow from operations	CF Opns
	− Capital expenditures	− Cap Exp
	− Additions to working capital	− Add WC
	− Repayment of debt principal	− Dept Pm
	+ Proceeds from new debt issues	+ Debt Proc
	= Free cash flow to equity	= FCFE

$$V_E = \sum_{t=0}^{\infty} \frac{FCFE_t}{(1 + k_E)^t} \tag{18.4}$$

EXAMPLE 18.2 | Choosing an Appropriate Valuation Approach

DECISION MAKING

Situation You have decided to make an offer for the recreational vehicle manufacturing business that you evaluated in Learning by Doing Applications 18.1, 18.2, and 18.3. Your analysis yielded the following enterprise value estimates:

Liquidation value	$ 8.45 million
Value from multiples analysis	
P/E multiple	$18.35 million
Enterprise/EBITDA multiple	$24.70 million
FCFF value	$24.58 million

The seller of the company is asking for $18 million. Is this price reasonable?

Decision The price appears to be reasonable. It is almost $10 million greater than the liquidation value, but the liquidation value does not include the going-concern value associated with the business. The other three estimates, which all reflect the company's going-concern value, suggest that the fair market value of the business is greater than the seller's asking price.

Summary of Key Equations

Equation	Description	Formula
18.1	Price/earnings multiple based on constant-growth model	$\frac{P_0}{E_1} = \frac{b}{k_{cs} - g}$
18.2	Implementing the income approach to business valuation	$V_F = PV(FCF_T) + PV(TV_T) + NOA$
18.3	FCFF approach	$V_F = \sum_{t=0}^{\infty} \frac{FCFF_t}{(1 + WACC)^t}$
18.4	FCFE approach	$V_E = \sum_{t=0}^{\infty} \frac{FCFE_t}{(1 + k_E)^t}$

Self-Study Problems

18.1 Your sister wants to open a store that sells antique-style jewelry and accessories. She has $15,000 of savings to invest, but opening the store will require an initial investment of $20,000. Net cash inflows will be −$2,000, −$1,000, and $0 in the first three months. As the store becomes better known, net cash inflows will become +$500 in the fourth month and grow at a constant rate of 5 percent in the following months. You want to help your sister by providing the additional money that she needs. How much money do you have to invest each month to start and to keep the store operating with a minimum cash balance of $1,000?

18.2 You have the following information for a company you are valuing and for a comparable company:

Comparable company	Company you are valuing
Stock price = $23.45	Value of debt = $3.68 million
Number of shares outstanding = 6.23 million	Est. EBITDA next year = $4.4 million
Value of debt = $18.45 million	Est. income next year = $1.5 million
Est. EBITDA next year = $17.0 million	
Est. income next year = $5.3 million	

Estimate the enterprise value of the company you are evaluating using the P/E and enterprise value/EBITDA multiples.

18.3 How do the cash flows that are discounted when the WACC approach (FCFF approach) is used to value a business differ from those that are discounted when the free cash flow to equity (FCFE) approach is used to value the equity in a business?

18.4 You are valuing a company using the WACC approach and have estimated that the free cash flows from the firm (FCFF) in the next five years will be $36.7, $42.6, $45.1, $46.3, and $46.6 million, respectively. Beginning in Year 6, you expect the cash flows to decrease at a rate of 3 percent per year for the indefinite future. You estimate that the appropriate WACC to use in discounting these cash flows is 10 percent. What is the value of this company?

18.5 You want to estimate the value of a local advertising firm. The earnings of the firm are expected to be $2 million next year. Based on expected earnings next year, the average price-to-earnings ratio of similar firms in the same industry is 48. Therefore, you estimate the value of the firm you are valuing to be $96 million.

Further investigation shows that a large portion of the firm's business is obtained through connections that John Smith, a senior partner of the firm, has with various advertising executives at customer firms. Mr. Smith only recently started working with his junior partners to establish similar relationships with these customers.

Mr. Smith is approaching 65 years of age and might announce his retirement at the next board meeting. If he does retire, revenues will drop significantly and earnings are estimated to shrink by 30 percent. You estimate that the probability that Mr. Smith will retire this year is 50 percent. If he does not retire this year, you expect that Mr. Smith will have sufficient time to work with his junior partners so his departure will not affect earnings when he departs. How does this information affect your estimate of the value of the firm?

Solutions to Self-Study Problems

18.1 You will have to invest $5,000 to open the store (the difference between $20,000 and $15,000). You will then have to invest an additional $3,000 during the first month to cover the cash flow of −$2,000 and to establish a cash balance of $1,000. Another $1,000 will be required in the second month to cover the negative cash flow during that month. Since cash flows will be $0 or positive beginning in the

third month, you will not have to invest any additional funds after the second month.

18.2 The P/E and enterprise value/EBITDA multiples for the comparable company are:

$$\left(\frac{P}{E}\right)_{\text{Comparable}} = \left(\frac{\text{Stock price}}{\text{Earnings per share}}\right)_{\text{Comparable}}$$

$$= \frac{\$23.45 \text{ per share}}{\$5.3 \text{ million}/6.23 \text{ million shares}}$$

$$= 27.6$$

$$\left(\frac{\text{Enterprise value}}{\text{EBITDA}}\right)_{\text{Comparable}} = \left(\frac{V_D + V_E}{\text{EBITDA}}\right)_{\text{Comparable}}$$

$$= \frac{\$18.45 \text{ million} + (\$23.45 \text{ per share} \times 6.23 \text{ million shares})}{\$17.0 \text{ million}}$$

$$= 9.68$$

Using the P/E multiple, we can calculate the value of the equity as:

$$V_E = \left(\frac{P}{E}\right)_{\text{Comparable}} \times \text{Net income}_{\text{Company being valued}}$$

$$= 27.6 \times \$1.5 \text{ million}$$

$$= \$41.4 \text{ million}$$

which suggests an enterprise value of:

$$V_F = V_E + V_D = \$41.4 \text{ million} + \$3.68 \text{ million} = \$45.08 \text{ million}$$

Using the enterprise/EBITDA multiple, we obtain:

$$V_F = \left(\frac{\text{Enterprise value}}{\text{EBITDA}}\right)_{\text{Comparable}} \times \text{EBITDA}_{\text{Company being valued}}$$

$$= 9.68 \times \$4.4 \text{ million}$$

$$= \$42.59 \text{ million}$$

18.3 The cash flows that are discounted when the WACC approach is used to value a business are calculated in the same way that the cash flows are calculated for a project analysis. These cash flows represent the total after-tax free cash flows that the business is expected to generate from operations. The cash flows that are discounted when the FCFE approach is used are the total after-tax free cash flows from the business that are available for distribution to the stockholders. In other words, they equal the total cash flows that the business is expected to generate less the net cash flows to the debt holders. The net cash flows to the debt holders is equal to the interest and principal payments that the firm makes less any proceeds for the sale of new debt.

18.4 The present value of the cash flows expected over the next five years is:

$$PV(FCFF_5) = \frac{\$36.7 \text{ million}}{1 + 0.1} + \frac{\$42.6 \text{ million}}{(1 + 0.1)^2} + \frac{\$45.1 \text{ million}}{(1 + 0.1)^3}$$

$$+ \frac{\$46.3 \text{ million}}{(1 + 0.1)^4} + \frac{\$46.6 \text{ million}}{(1 + 0.1)^5}$$

$$= \$163.01 \text{ million}$$

The terminal value is:

$$TV_5 = \frac{FCFF_5 \times (1 + g)}{WACC - g} = \frac{\$46.6 \text{ million} \times (1 - 0.03)}{0.1 + 0.03} = \$347.71 \text{ million}$$

and the present value of the terminal value is:

$$PV(TV_5) = \frac{TV_5}{(1 + WACC)^5} = \frac{\$347.71 \text{ million}}{(1 + 0.1)^5} = \$215.90 \text{ million}$$

Therefore, if there are no nonoperating assets, the value of the firm is:

$$V_F = \$163.01 \text{ million} + \$215.90 \text{ million} = \$378.91 \text{ million}$$

18.5 Mr. Smith is a *key person* in this firm. An adjustment should be made to the valuation to account for his potential departure this year.

Taking the possibility that Mr. Smith will retire into account, the expected earnings next year will be:

$$(\$2{,}000{,}000 \times 0.5) + [\$2{,}000{,}000 \times (1 - 0.30) \times 0.5] = \$1{,}700{,}000$$

Therefore, the adjusted value for the firm is \$1.7 million × 48 = \$81.6 million. We can see that this implies a 15 percent key person discount from the original estimate of \$96 million [(\$81.6 million − \$96.0 million)/\$96.0 million = −0.15, or −15 percent].

Discussion Questions

18.1 Given that many new businesses fail in the first few years after they are established, how should an entrepreneur think about the risk of failure associated with a new business? From what you have learned in this chapter, what can an entrepreneur do to increase the chance of success?

18.2 Explain how the taxation of a C-corporation differs from the taxation of the other forms of business organization discussed in this chapter.

18.3 What is a business plan? Explain how a business plan can help an entrepreneur succeed in building a business.

18.4 You are entering negotiations to purchase a business and are trying to formulate a negotiating strategy. You want to determine the minimum price you should offer and the maximum you should be willing to pay. Explain how the concepts of fair market value and investment value can help you do this.

18.5 You have just received a business valuation report that is dated six months ago. Describe the factors that might have changed during the past six months and, therefore, caused the value of the business today to be different from the value six months ago. Which of these changes affect the expected cash flows, and which affect the discount rate that you would use in a discounted cash flow valuation of this company?

18.6 Is the replacement cost of a business generally related to the value of the cash flows that the business is expected to produce in the future? Why or why not? Illustrate your answer with an example.

18.7 You want to estimate the value of a company that has three very different lines of business. It manufactures aircraft, is in the data processing business, and manufactures automobiles. How could you use an income approach to value a company such as this—one with three very distinct businesses that will have different revenue growth rates, profit margins, investment requirements, discount rates, and so forth?

18.8 Your boss has asked you to estimate the intrinsic value of the equity for Google, which does not currently pay any dividends. You are going to use an income approach and are trying to choose between the free cash flow to equity (FCFE) approach and the dividend discount model (DDM) approach. Which would be more appropriate in this instance? Why? What concerns would you have in applying either of these valuation approaches to a company such as this?

18.9 Explain how the financial statements of a private company might differ from those of a public company. What does this imply for valuing a private company?

18.10 Explain why it is difficult to value a young, rapidly growing company.

Questions and Problems

Basic

18.1 **Organizational form:** List some common forms of business organization, and discuss how access to capital differs across these forms of organization.

18.2 **Starting a business:** What are some of the things that the founder of a company must do to launch a new business?

18.3 Organizational form: Explain how financial liabilities differ among different forms of business organization.

18.4 Cash requirements: List two useful tools to help an entrepreneur to understand the cash requirements of a business and to estimate the financing needs of that business.

18.5 Cash requirements: You believe you have a great business idea and want to start your own company. However, you do not have enough savings to finance it. Where can you get the additional funds you need?

18.6 Raising capital: Why is it especially difficult for an entrepreneur with a new business to raise capital? What tool can help him or her to raise external capital?

18.7 Replacement cost: What is the replacement cost of a business?

18.8 Multiples analysis: It is April 4, 2018, and your company is considering the possibility of purchasing the Chrysler automobile manufacturing business. Managers of Fiat Chrysler Automobiles N.V., the automobile manufacturer that owns Chrysler, have hinted that they might be interested in selling Chrysler. Since Chrysler does not have publicly traded shares of its own, you have decided to use Ford Motor Company as a comparable company to help you determine the market value of Chrysler.

This morning, Ford's common stock was trading at $11.75 per share, and the company had 3.9 billion shares outstanding. You estimated that the market value of all of the company's other outstanding securities (excluding the common stock but including special shares owned by the Ford family) is $35.0 billion and that its revenues from auto sales were $155.0 billion last year. Chrysler's revenue in 2017 was $50.0 billion. Based on the enterprise value/revenue ratio, what is the total value of Chrysler that is implied by the Ford market values?

18.9 Nonoperating assets: Why is excess cash a nonoperating asset (NOA)? Why does it make sense to add the value of excess cash to the value of the discounted cash flows when we use the WACC (FCFF) or FCFE approach to value a business?

18.10 Dividend discount approach: You want to estimate the total intrinsic value of a large gas and electric utility company. This company has publicly traded stock and has been paying a regular dividend for many years. You decide that, due to the predictability of the dividend that this company pays, you can use the dividend discount valuation approach. The company is expected to pay a dividend of $1.25 per share next year, and the dividend is expected to grow at a rate of 3 percent per year thereafter. You estimate that the appropriate rate for discounting future dividends is 12 percent. In addition, you know that the company has 46 million shares outstanding and that the market value of its debt is $350 million. What is the total enterprise value of the company?

18.11 Public versus private company valuation: You are considering investing in a private company that is owned by a friend of yours. You have read through the company's financial statements and believe that they are reliable. Multiples of similar publicly traded companies in the same industry suggest that the value of a share of stock in your friend's company is $12. Should you be willing to pay $12 per share?

18.12 Control: Does the expected rate of return that is calculated using CAPM, with a beta estimated from stock returns in the public market, reflect a minority or a controlling ownership position? How is it likely to differ between a minority and a controlling position?

Intermediate

18.13 Organizational form: Compare the characteristics of an LLC with those of a partnership and a C-corporation.

18.14 Organizational form: Discuss the pros and cons of an S-corporation compared with a C-corporation.

18.15 Break-even point: You have started a business that sells a home gardening system that allows people to grow vegetables on their kitchen countertop. You are considering two options for marketing your product. The first is to advertise on local TV. The second is to distribute flyers in the local community. The TV option, which costs $50,000 annually, will promote the product more effectively and create a demand for 1,200 units per year. The flyer advertisement option costs only $6,000 annually, but will create a demand for only 250 units per year. The price per unit of the indoor gardening system is $100, and the variable cost is $60 per unit. Assume that the production capacity is not limited and that the marketing cost is the only fixed cost involved in your business. What are the break-even points for both marketing options? Which one should you choose?

18.16 Going-concern value: Aggie Motors is a chain of used car dealerships that has publicly traded stock. Using the adjusted book value approach, you have estimated the value of Aggie Motors to be $45,646,000. The company has $40.5 million of debt outstanding. Its stock price is $5.5 per share, and there are 1,378,000 shares outstanding. What is the going-concern value of Aggie Motors?

Use the following information concerning Johnson Machine Tool Company in Problems 18.17, 18.18, and 18.19.

Johnson's income statement from the fiscal year that ended this past December is:

Revenue	$995
Cost of goods sold	652
Gross profit	$343
Selling, general, and administrative expenses	135
Operating profit (EBIT)	$208
Interest expense	48
Earnings before taxes	$160
Taxes	64
Net income	$ 96

All dollar values are in millions. Depreciation and amortization expenses last year were $42 million, and the company has $533 million of debt outstanding.

18.17 Multiples analysis: You are an analyst at a private equity firm that buys private companies, improves their operating performance, and sells them for a profit. Your boss has asked you to estimate the fair market value of the Johnson Machine Tool Company. Billy's Tools is a public company with business operations that are virtually

identical to those at Johnson. The most recent income statement for Billy's Tools is as follows:

Revenue	$1,764
Cost of goods sold	1,168
Gross profit	$ 596
Selling, general, and administrative expenses	211
Operating profit (EBIT)	$ 385
Interest expense	12
Earnings before taxes	$ 373
Taxes	147
Net income	$ 226

All dollar values are in millions. Billy's had depreciation and amortization expenses of $71 million last year and had 200 million shares and $600 million of debt outstanding as of the end of the year. Its stock is currently trading at $12.25 per share.

Using the P/E multiple, what is the per share value of Johnson's stock? What is the total value of Johnson Machine Tool Company?

18.18 **Multiples analysis:** Using the enterprise value/EBITDA multiple, what is the total value of Johnson Machine Tool Company? What is the per share value of Johnson's stock?

18.19 **Multiples analysis:** Which of the above multiples analyses do you believe is more accurate for valuing the firm and its stock?

18.20 **Income approaches:** You are using the FCFF approach to value a business. You have estimated that the FCFF for next year will be $123.65 million and that it will increase at a rate of 8 percent for each of the following four years. After that point, the FCFF will increase at a rate of 3 percent forever. If the WACC for this firm is 10 percent and it has no NOA, what is it worth?

18.21 **Valuing a private business:** You want to estimate the value of a privately owned restaurant that is financed entirely with equity. Its most recent income statement is as follows:

Revenue	$3,000,000
Cost of goods sold	600,000
Gross profit	$2,400,000
Salaries and wages	1,400,000
Selling expenses	100,000
Operating profit (EBIT)	$ 900,000
Taxes	315,000
Net income	$ 585,000

You note that the profitability of this restaurant is significantly lower than that of comparable restaurants, primarily due to high salary and wage expenses. Further investigation reveals that the annual salaries for the owner and his wife, the firm's accountant, are $900,000 and $300,000, respectively. These salaries are much higher than the industry median salaries for these two positions of $100,000 and $50,000, respectively. Compensation for other employees ($200,000 in total) appears to be consistent with the market rates. The median P/E ratio of comparable restaurants with no debt is 10. What is the total value of this restaurant?

18.22 **Valuing a private business:** A few years ago, a friend of yours started a small business that develops gaming software. The company is doing well and is valued at $1.5 million based on multiples for comparable public companies after adjustments for their lack of marketability. With 300,000 shares outstanding, each share is estimated to be worth $5. Your friend, who has been serving as CEO and CTO (chief technology officer), has decided that he lacks sufficient managerial skills to continue to build the company. He wants to sell his 160,000 shares and invest the money in an MBA education. You believe you have the appropriate managerial skills to run the company. Would you pay $5 each for these shares? What are some of the factors you should consider in making this decision?

Advanced

18.23 You plan to start a business that sells waterproof sun block with a unique formula that reduces the damage of UVA radiation 30 percent more effectively than similar products on the market.

You expect to invest $50,000 in plant and equipment to begin the business. The targeted price of the sun block is $15 per bottle. You forecast that unit sales will total 1,500 bottles in the first month and will increase by 20 percent in each of the following months during the first year. You expect the cost of raw materials to be $3 per bottle. In addition, monthly gross wages and payroll are expected to be $13,000, rent is expected to be $3,000, and other expenses are expected to total $1,000. Advertising costs are estimated to be $35,000 in the first month, but to remain constant at $5,000 per month during the following eleven months.

You have decided to finance the entire business at one time using your own savings. Is an initial investment of $75,000 adequate to avoid a negative cash balance in any given month? If not, how much more do you need to invest up front? How much do you need to invest up front to keep a minimum cash balance of $5,000? What is the break-even point for the business?

18.24 For the previous question, assume that you do not have sufficient savings to cover the entire amount required to start your sun-block business. You are going to have to get external financing. A local banker whom you know has offered you a six-month loan of $20,000 at an APR of 12 percent. You will pay interest each month and repay the entire principal at the end of six months.

Assume that instead of making a single up-front investment, you are going to finance the business by making monthly investments as cash is needed in the business. If the proceeds from the loan go directly into the business on the first day and are therefore available to pay for some of the capital expenditures, how much money will you need to take from your savings account every month to run the business and keep the cash balances positive?

18.25 Your friend is starting a new company. He wants to write a business plan to clarify the company's business outlook and raise venture capital. Knowing that you have taken this course, he has asked you, as a favor, to help him prepare a template for a business

plan. Prepare a template that includes the key elements of a business plan.

18.26 A friend of yours is trying to value the equity of a company and, knowing that you have read this book, has asked for your help. So far she has tried to use the FCFE approach. She estimated the cash flows to equity to be as follows:

Sales	$ 800.0
− CGS	−450.0
− Depreciation	−80.0
− Interest	−24.0
Earning before taxes (EBT)	$ 246.0
− Taxes (0.35 × EBT)	−86.1
= Cash flow to equity	$159.9

She also computed the cost of equity using CAPM as follows:

$$k_E = k_F + \beta_E(\text{Risk premium}) = 0.06 + (1.25 \times 0.084)$$
$$= 0.165, \text{ or } 16.5\%$$

where the beta is estimated for a comparable publicly traded company.

Using this cost of equity, she estimates the discount rate as

$$\text{WACC} = x_{\text{Debt}} k_{\text{Debt pretax}}(1 - t) + x_{cs} k_{cs}$$
$$= [0.20 \times 0.06 \times (1 - 0.35)] + (0.80 \times 0.165)$$
$$= 0.14, \text{ or } 14\%$$

Based on this analysis, she concludes that the value of equity is $159.9 million/0.14 = $1,142 million.

Assuming that the numbers used in this analysis are all correct, what advice would you give your friend regarding her analysis?

18.27 Forever Youth Technology is a biochemical company that is two years old. Its main product, an antioxidant drink that is supposed to energize the consumer and delay aging, is still under development. The company's equity consists of $5 million invested by its founders and $5 million from a venture capitalist. The company has spent $3 million in each of the past two years, mostly on lab equipment and R&D costs. The company has had no sales so far. What are the challenges associated with valuing such a young and uncertain company?

18.28 Mad Rock Inc. is a company that sells music online. It is expected to generate earnings of $1 per share this year after its Web site is upgraded and online marketing is stepped up. The stock price of Mad Rock has rocketed from $8 to $95 per share in the past 12 months. The cost of capital for the company is 18 percent.

Of course, the future of a young Internet company such as Mad Rock is highly uncertain. Nevertheless, using the very limited information provided in this problem, do you think $95 per share could be a fair price for its stock? Support your argument with a simple analysis.

18.29 At the end of 2016 the value of the S&P 500 Index divided by the estimated 2016 earnings for S&P 500 firms (the S&P 500 P/E multiple) was 25.54. Assume that the long-term Treasury bond yield was 2.88 percent, the market risk premium was 5.92 percent, and firms in the S&P 500 were expected to pay out an average of 40.2 percent of their earnings as dividends in the future. At what rate were dividends paid by S&P 500 firms expected to grow in the future?

18.30 The S&P 500 P/E multiple of 25.54 at the end of 2016 was higher than its historical average of approximately 15. Some financial commentators argued that this meant that the firms in the S&P 500 were, on average, overvalued at the end of 2016. Based on your analysis in Problem 18.29 and the concepts covered in this book, do you think that these commentators are right or wrong? Why or why not?

18.31 You own a company that produces and distributes course packets for classes at local universities via the Internet. You have asked a friend to invest $35,000 in the business. Your friend wants to know what the business is worth so that he can determine how much of the equity (e.g., what percentage) he should expect to receive for his investment. You offer to help him value the business.

The business is expected to generate revenue of $110,000 and incur cash operating expenses of $70,000 next year. Over the following three years, revenue and cash operating expenses are expected to increase 15 percent, 10 percent, and 7 percent. After Year 4, they are expected to grow 2 percent per year forever. Depreciation and amortization, capital expenditures, and additions to working capital are expected to equal 5 percent, 6 percent, and 1 percent of revenue, respectively, in the future. You have determined that a target capital structure of 10 percent is reasonable for this business. With this capital structure, the pretax cost of debt will be 6 percent and the beta for the equity will be 1.30. The average tax rate for the business is 10 percent, and the marginal rate is 20 percent. The risk-free rate is 4.25 percent, and the market risk premium is 6.01 percent. What is a 100 percent equity interest in the business worth? What percentage of the equity should your friend get for his investment?

Sample Test Problems

18.1 You plan to start a business to produce and sell custom kitchen cabinets. The targeted price for each order of cabinets is $10,000. You estimate that you will receive orders for cabinets for eight kitchens in each of the first two months, nine kitchens in the third month, and ten kitchens in the fourth month. The cost of the equipment necessary to produce the cabinets is $105,000. You expect the cost of raw materials to be $3,000 per order. In addition, you expect monthly gross wages and payroll to be $27,000, rent to be $8,000, and other expenses to total $4,000. You also expect advertising costs to be $10,000 in the first month but to remain constant at $1,000 per month during the following three months. How much will you have to initially invest to ensure that you have a cash balance of $10,000 at the beginning of the second month? If you invest this amount, what will be your cash balance at the end of the fourth month?

18.2 Which of the following is/are usually included in an entrepreneur's business plan?

a. Detailed description of the company's products and services.

b. Discussion of the management team, including organizational structure.

c. A listing of the types of securities that have been issued and who owns them.

d. A market analysis.

e. All of the above are typically included in a business plan.

18.3 Sessler Corporation is a private company that had EBIT of $186 million and depreciation and amortization of $22 million in the most recent fiscal year. At the end of that year, a similar, public firm has an enterprise value/EBITDA multiple of 4.3. What is the implied enterprise value of Sessler?

18.4 Winters Inc. management estimates that the company will generate after-tax free cash flows from the firm (FCFF) of $12.5 million, $16.8 million, and $19.7 million, respectively, over the next three years. After that, FCFF are expected to grow at a constant 5 percent per year forever. The company has $5 million in nonoperating assets. If the appropriate WACC is 8 percent, what is the enterprise value of this business?

18.5 Do private companies have audited financial statements prepared in accordance with GAAP?

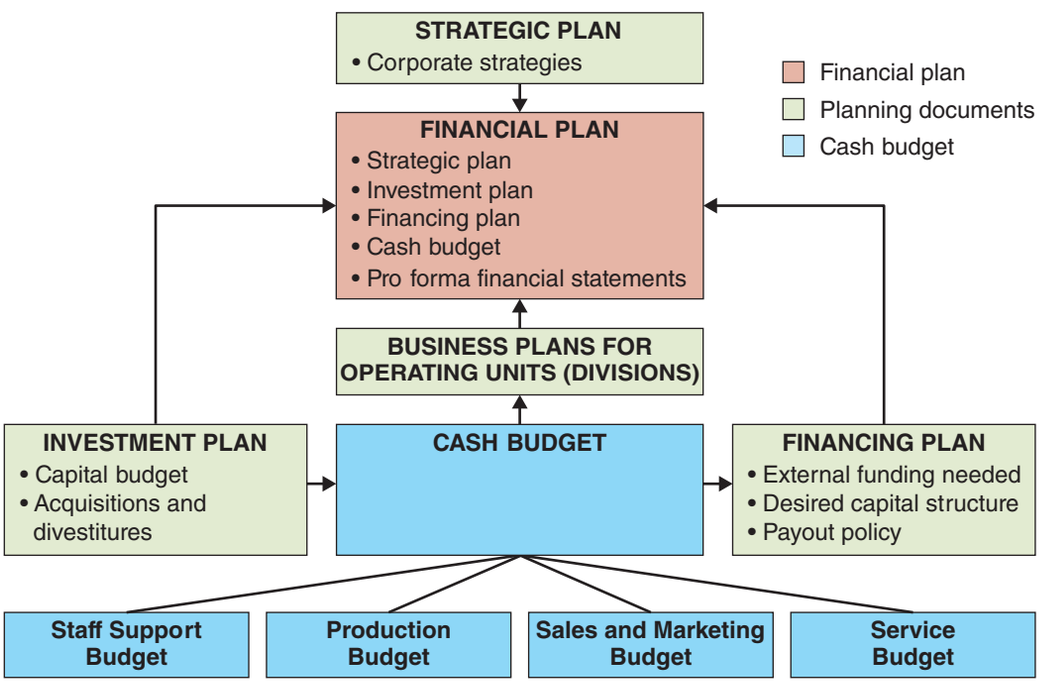


EXHIBIT 19.1 **The Financial Planning Process**

Various planning and budget documents flow into a financial plan and form its foundation. The completed financial plan articulates the firm's strategic goals and identifies what types of investments the firm should make to achieve its goals, as well as how to finance those investments.

$$\%\Delta S = \frac{(S_{t+1} - S_t)}{S_t} \tag{19.1}$$

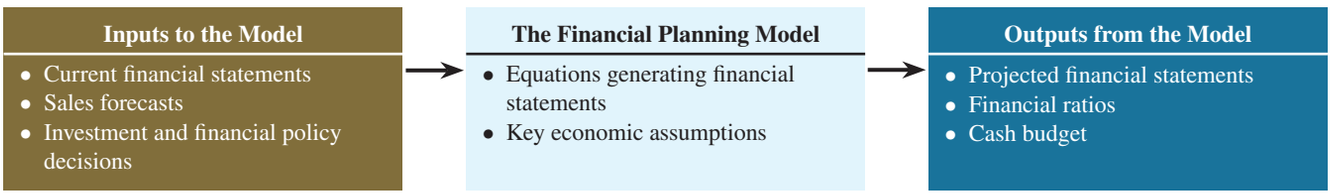


EXHIBIT 19.2 **The Components of a Financial Planning Model**

We can categorize the parts of a financial planning model as inputs, the model itself, and outputs. Models allow management to generate projected financial statements that enable them to see the financial impact of strategic initiatives.

LEARNING BY DOING

APPLICATION 19.1 | Financial Statement Items Often Vary with Sales

Problem You have the following information: (1) sales this year are $50 million; (2) sales are expected to grow by 20 percent next year; and (3) for the current year, accounts receivable are 7 percent of sales and inventory is 10 percent of sales. Your boss has asked you to estimate next year's sales, accounts receivable, and inventory.

Approach You can rearrange Equation 19.1 to find next year's sales level (S_{t+1}). Then, assuming accounts receivable and inventory grow proportionately with sales, you can use the result to calculate the expected levels of accounts receivable and inventory for next year.

Solution

$$\%\Delta S = \frac{(S_{t+1} - S_t)}{S_t}$$

$$0.2 = \frac{(S_{t+1} - \$50{,}000{,}000)}{\$50{,}000{,}000}$$

$$S_{t+1} = (0.2 \times \$50{,}000{,}000) + \$50{,}000{,}000$$

$$= \$60{,}000{,}000$$

$$\text{Accounts receivable} = \$60{,}000{,}000 \times 0.07 = \$4{,}200{,}000$$

$$\text{Inventory} = \$60{,}000{,}000 \times 0.10 = \$6{,}000{,}000$$

Figure 19.1

Sleepy Hollow Corporation
Current Financial Statements ($ millions)

Income Statement		Balance Sheet			
Net sales	$1,000	Assets	$600	Debt	$400
Costs	700			Equity	200
Net income	$ 300	Total	$600	Total	$600

Figure 19.2

Sleepy Hollow Corporation Pro Forma Balance Sheet ($ millions)					
Assets	$690	($90)	Debt	$460	($60)
			Equity	230	(30)
Total	$690	($90)	Total	$690	($90)

Figure 19.3

Sleepy Hollow's Building Project Preliminary Pro Forma Balance Sheet ($ millions)					
Assets	$690	($90)	Debt	$400	
New facility	200	($200)	Equity	230	(30)
Total	$890		Total	$630	

Figure 19.4

Sleepy Hollow's Building Project Final Pro Forma Balance Sheet ($ millions)					
Assets	$690	($90)	Debt	$660	($260)
New facility	200	(200)	Equity	230	(30)
Total	$890	($290)	Total	$890	($290)

DECISION MAKING

EXAMPLE 19.1 | Informed Judgment about Risk

Situation You are given some additional information about Sleepy Hollow Corporation's use of financial leverage, as shown:

Debt to total assets before capital project = $400/$600 = 66.7%
Debt to total assets after capital project = $660/$890 = 74.2%
Industry average debt to total assets = 40.0%

What should management do in light of this information?

Decision Sleepy Hollow's current leverage ratio of 66.7 percent is already high compared with the industry average of 40 percent. If the firm goes ahead with the project, the leverage ratio will increase to 74.2 percent, which is even higher. The high debt ratio makes the firm's cash flows more risky and could negatively affect its stock price, its borrowing cost, and even its ability to borrow money. A more

prudent alternative would be to fund at least part of the $290 million of new assets ($90 million + $200 million = $290 million) with internally generated funds by reducing dividends or with externally raised equity by selling new stock, or both.

The important point here is that financial planning models do not think for management. Even though the balance sheet balances and results are consistent with the firm's financing plan, management must apply informed judgment.

EXHIBIT 19.3 **Blackwell Sales: Current and Pro Forma Income Statements ($ thousands)**

The pro forma income statement for Blackwell Sales assumes that the income statement items vary directly with sales.

	Current	Pro Forma	Assumptions
Net sales	$2,000	$2,600	Sales increase: 30%
Costs	1,700	2,210	Total costs = 85% of sales
Taxable income	$ 300	$ 390	
Taxes (34.1%)	102	133	
Net income	$ 198	$ 257	
Dividends	$ 66	$ 86	Dividend policy: 33.5% of net income
Addition to retained earnings	$ 132	$ 171	

The Income Statement

Exhibit 19.3 shows the firm's current (most recent) and pro forma income statements. Let's look at the calculations used to arrive at the pro forma income statement. Management expects sales to increase by 30 percent next year, and so projected sales are \$2 million × 1.30 = \$2.6 million. Since total costs have averaged 85 percent of sales, projected total costs are \$2.6 million × 0.85 = \$2.21 million. Projected taxes, which are 34.1 percent of taxable income, are 0.341 × \$390,000 = \$132,990, which we will round to \$133,000 for simplicity. Subtracting taxes from taxable income, we arrive at the firm's projected net income of \$257,000.

Blackwell's cash dividend is \$86,000 (0.335 × \$257,000 = \$86,095, which we will round to \$86,000), and the remaining \$171,000 of net income (0.665 × \$257,000 = \$170,905) is retained in the firm as an addition to retained earnings.

These amounts relate to two ratios we will use in this chapter: the **dividend payout ratio** and the **retention ratio**, or **plowback ratio**. The formulas and calculations for Blackwell are as follows:

$$\text{Dividend payout ratio} = \frac{\text{Cash dividends}}{\text{Net income}} \tag{19.2}$$

$$= \frac{\$86{,}000}{\$257{,}000} = 0.335, \text{ or } 33.5\%$$

$$\text{Retention (plowback) ratio} = \frac{\text{Addition to retained earnings}}{\text{Net income}} \tag{19.3}$$

$$= \frac{\$171{,}000}{\$257{,}000} = 0.665, \text{ or } 66.5\%$$

The dividend payout ratio shows the percentage of the firm's earnings paid out as cash dividends to stockholders. Similarly, the retention ratio tells what percentage of the firm's earnings is retained in the firm. Generally speaking, smaller, fast-growing companies plow back all or most of their earnings into the business, whereas more established firms with slower growth rates and larger cash flows distribute more of their profits to stockholders. Notice that the sum of the retention ratio and the dividend payout ratio equals 1.000 (0.335 + 0.665 = 1.000). This is because every dollar of net income is either paid out as a cash dividend or retained in the firm.

The Balance Sheet

To generate a pro forma balance sheet, we start with the current balance sheet, as shown in **Exhibit 19.4**. For each account that varies directly with sales, the exhibit gives the relation as a percent of sales for the current year. Notice that these percentages differ among the accounts. How do we determine which accounts vary with sales, and how do we know the relevant percentages? Fortunately, the process is straightforward.

EXHIBIT 19.4 **Blackwell Sales: Current Balance Sheet ($ thousands)**

In this balance sheet for Blackwell Sales, many accounts vary directly with sales. The projected percent of sales is shown for each of these accounts. The accounts labeled "n/a" do not change proportionately with sales.

Assets			Liabilities and Stockholders' Equity		
	Current	Projected % of Sales		Current	Projected % of Sales
Current assets			Current liabilities		
Cash	$ 100	5%	Accounts payable	$ 60	4%
Accounts receivable	120	6	Notes payable	140	n/a
Inventory	140	7	Total	$ 200	n/a
Total	$ 360	18%	Long-term debt	$ 200	n/a
			Owner's equity		
			Common stock	$ 10	n/a
			Retained earnings	590	n/a
			Total equity	$ 600	n/a
Net fixed assets	640	32	Total liabilities and		
Total assets	$1,000	50%	stockholders' equity	$1,000	50%

Historical Trends

We begin by looking at balance sheet accounts that might vary with sales. To do this we gather four or five years of historical accounting data and express those data as a percent of sales. A trend may be self-evident, or some simple trend lines can be fit to the data to identify trends. In either case, this process allows the financial manager to decide which financial accounts can safely be estimated as a percent of sales and which must be forecast using other information.

The following table shows several years of historical data from Blackwell's balance sheet accounts, and the far-right column contains the final forecast values for 2018. We now discuss the rationale for assigning a percent of sales figure to each balance sheet account. We look first at the working capital accounts: cash, accounts receivable, inventory, and accounts payable.

	Percent of Sales				
	2014	2015	2016	2017	Forecast 2018
Cash	5%	5%	4%	5%	5%
Accounts receivable	10	9	9	9	6
Inventory	7	8	7	6	7
Accounts payable	4	4	4	3	4
Net fixed assets	30	32	34	32	32

Working Capital Accounts

The key working capital accounts tend to vary directly with sales. Take inventory as an example. As sales increase, the firm needs to increase the level of inventory proportionately to support the higher sales level. The historical data in the table support this view. Inventory levels have been a relatively constant percentage of sales, varying from 6 to 8 percent. In selecting the appropriate percentage for the planning process, management must consider what the firm's optimal inventory ratio is. On the one hand, as discussed in Chapter 14, management would like to minimize inventory levels, because inventory is expensive to finance. On the other hand, if inventory levels become too low, the firm may lose sales because of stockouts, which occur when an order comes in and there is no product to sell. Let's assume that Blackwell's management determines that 7 percent of projected sales is the right inventory-to-sales ratio for the firm.

The ratio of accounts receivable to sales has been 9 percent for the last several years. However, firms with similar credit policies operate with a receivables-to-sales ratio of 6 percent. As sales have increased, Blackwell has provided proportionately more credit to its customers. To improve the firm's performance to industry standards, management decides to collect receivables more aggressively and targets a ratio of 6 percent. Management has also targeted cash accounts totaling 5 percent of sales. Management believes that a 5 percent cash ratio provides adequate liquidity to fund ongoing operations and pay for unexpected emergencies yet does not tie up an excessive amount of cash in low-yielding assets.

On the liability side, the firm's historical data show that accounts payable vary with sales. This seems reasonable, since the greater a firm's sales, the more orders the firm will have to place with its suppliers. Management is satisfied with the firm's vendor relationships and the payment schedule for vendors. Hence, accounts payable are forecast to be 4 percent of sales.

Fixed Assets

We assume that the company's net fixed assets vary with the level of sales. An examination of historical data confirms that this is a reasonable assumption. Blackwell's management decides to use the firm's four-year historical average—32 percent—for the projected ratio of fixed assets to sales. Thus, for every $100 in sales, the firm needs $32 of fixed assets to support the sales.

We should note that such a relation between fixed assets and sales may not always hold. The reason is that fixed assets may vary directly with sales only when a firm is operating at full capacity and fixed assets can be added in small increments. For example, if a firm has a large amount of unused capacity, its sales could increase by 20 percent without adding any new fixed assets. We will come back to this issue in more detail later in the chapter. For Blackwell, the data support the proportional fixed assets-to-sales ratio, so we can proceed on that basis.

As a final comment, notice in Exhibit 19.4 on the asset side of the balance sheet that the total percent of sales for asset items adds up to 50 percent. This means that total assets are 50 percent of sales. The ratio of total assets to sales is called the *capital intensity ratio* and is calculated for Blackwell Sales as follows:

$$\text{Capital intensity ratio} = \frac{\text{Total assets}}{\text{Net sales}} \tag{19.4}$$

$$= \frac{\$1 \text{ million}}{\$2 \text{ million}} = 0.5, \text{ or } 50\%$$

The capital intensity ratio, which is the inverse of the total asset turnover ratio discussed in Chapter 4 (Equation 4.7), tells us something about the amount of assets the firm needs to generate $1 in sales. The higher the ratio, the more capital the firm needs to generate sales—that is, the more *capital intensive* the firm. Firms that are highly capital intensive tend to be more risky than similar firms that use less fixed assets. High capital intensities are generally associated with high fixed assets and correspondingly high fixed costs. If there is a downturn in sales, profits decrease sharply for firms with high fixed costs because fixed costs cannot be reduced in the short term. This is the operating leverage concept that is illustrated in Exhibit 16.3 in Chapter 16. With a 50 percent capital intensity ratio, Blackwell Sales is not a highly capital-intensive firm. Examples of capital-intensive industries are the airline and the automobile industries; for example, both United Airlines and Ford Motor Company have capital intensity ratios greater than 100 percent.

Liabilities and Equity

For most firms, the remaining liability accounts on the balance sheet do not vary with sales. Their values typically change because of management decisions, such as the decision to pay off a loan or issue debt. Thus, each liability and equity account must be evaluated separately.

Turning to individual accounts, notes payable typically represent short-term borrowing. This account value will only change with some decision by Blackwell's management, such as making a payment on a note or borrowing more money from a bank. Thus, the account's value does not vary with sales, as indicated by the "n/a," or "not applicable," in Exhibit 19.4. Similarly, the account value for long-term debt changes only when management decides to issue or retire debt. The same argument holds for the common stock account, which changes only when management decides to sell or repurchase common shares. The last account is

retained earnings. Retained earnings may or may not vary directly with sales. The reason for the ambiguity is that the amount of funds in retained earnings depends not only on the firm's earnings but also on the firm's payout policy, which is set by management. Thus, for now, both the common stock and the retained earnings accounts are entered as n/a in Exhibit 19.4.

EXHIBIT 19.5 **Blackwell Sales: Preliminary Pro Forma Balance Sheet ($ thousands)**

This preliminary pro forma balance sheet for Blackwell Sales is a first approximation in deciding how to fund anticipated growth. At this stage of the analysis, the balance sheet will not balance (Total Assets will not equal Liabilities and Stockholders' Equity), and the difference will be the plug value, which is usually the amount of external funding the firm will need in order to fund investments and operations.

Assets			Liabilities and Stockholders' Equity		
	Projected	Change		Projected	Change
Current assets			Current liabilities		
Cash	$ 130	$ 30	Accounts payable	$ 104	$ 44
Accounts receivable	156	36	Notes payable	140	0
Inventory	182	42	Total	$ 244	$ 44
Total	$ 468	$108	Long-term debt	$ 200	$ 0
			Owner's equity		
			Common stock	$ 10	$ 0
			Retained earnings	761	171
			Total equity	$ 771	$171
Net fixed assets	832	192	Total liabilities and		
Total assets	$1,300	$300	stockholders' equity	$1,215	$215
			External funding needed (EFN)	$ 85	

EXHIBIT 19.6 **Blackwell Sales: Final Pro Forma Balance Sheet ($ thousands)**

The final pro forma balance sheet reflects Blackwell management's decision to temporarily suspend dividends and fund its growth with internal funds (retained earnings). Although financial models can determine the amount of EFN needed, management must make the final decision about how to fund the firm's capital requirements.

Assets			Liabilities and Stockholders' Equity		
	Projected	Change		Projected	Change
Current assets			Current liabilities		
Cash	$ 130	$ 30	Accounts payable	$ 104	$ 44
Accounts receivable	156	36	Notes payable	139	−1
Inventory	182	42	Total	$ 243	$ 43
Total	$ 468	$108	Long-term debt	$ 200	$ 0
			Owner's equity		
			Common stock	$ 10	$ 0
			Retained earnings	847	257
			Total equity	$ 857	$257
Net fixed assets	832	192	Total liabilities and		
Total assets	$1,300	$300	stockholders' equity	$1,300	$300
			External funding needed (EFN)	$ 0	

APPLICATION 19.2 | Blackwell's Alternative Plan

LEARNING BY DOING

Problem Let's continue the Blackwell Sales example. Suppose that Blackwell's management now decides to pay a cash dividend, but to reduce the payout to 10 percent of net income. Reconcile Blackwell's retained earnings account.

Approach First, we must calculate the new dividend payout and the amount of funds going into retained earnings. Since net income remains unchanged at $257,000, we calculate the dividends and addition to retained earnings by multiplying the net income by the payout and the retention percentages. Second, we must calculate the impact of the new dividend policy on the retained earnings account. An easy way to do this is to reconcile the retained earnings account.

Solution The calculations for the new dividend payout and the addition to retained earnings are:

(1) Cash dividends = 0.10 × $257,000 = $25,700.
(2) Addition to retained earnings = 0.90 × $257,000 = $231,300.

The calculations to reconcile the retained earnings account are:

Beginning retained earnings balance	$590,000
+ Net income	257,000
− Dividends	25,700
Ending retained earnings balance	$821,300

Thus, the new retained earnings balance is $821,300.

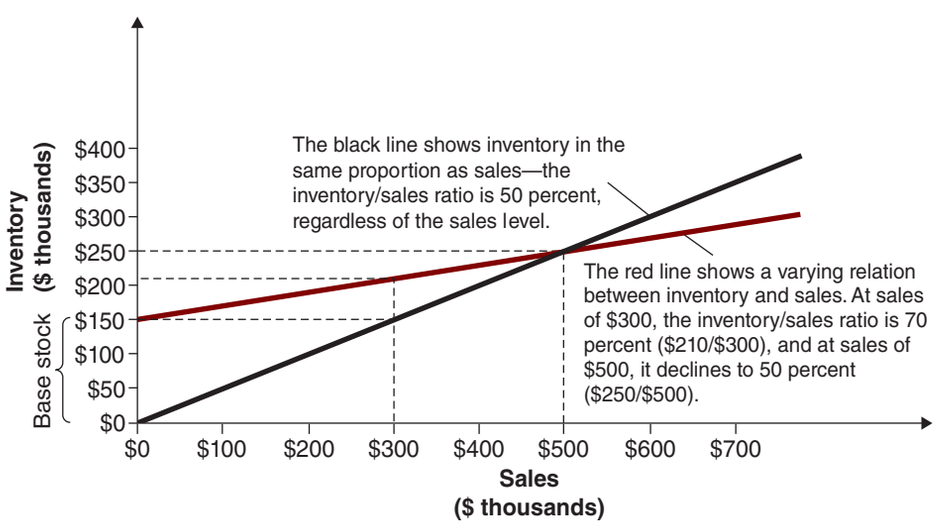


EXHIBIT 19.7 **Relation between Inventory Levels and Changes in Sales**

This graph shows inventory-to-sales ratios for two situations: one in which inventory varies directly with sales (black line) and one in which it does not (red line). Financial managers know from experience that most working capital accounts, such as inventory, do not increase directly with sales. Instead, they increase at a decreasing rate as sales increase.

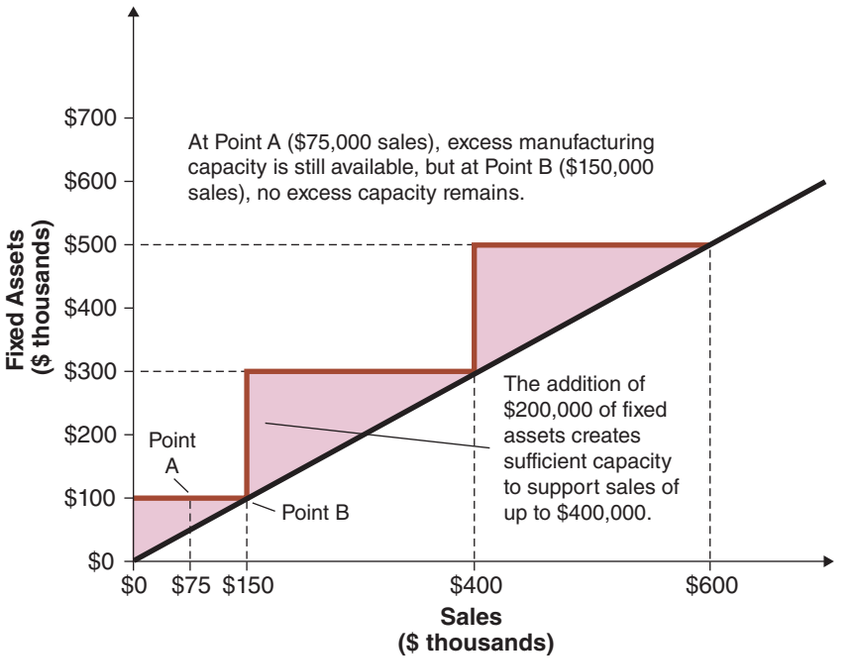


EXHIBIT 19.8 **Fixed Assets Are Usually Acquired in Large, Discrete Units**

In real-world situations, fixed assets usually do not vary directly with sales, as we assumed with our simplified financial models. Management often adds fixed assets in very large increments in order to add capacity in the most economical way.

EXHIBIT 19.9 **Empire Enterprises: Income Statement and Balance Sheet ($ millions)**

The exhibit shows the current income statement and balance sheet for Empire Enterprises. Management believes that the firm can increase sales by 20 percent for the coming year. All costs and assets are assumed to grow at the same rate as sales, 60 percent of earnings are paid out as dividends, and the directors do not want to issue additional common stock.

Income Statement

Net sales	$100.0
Costs	90.0
Net income	$ 10.0
Dividends	$ 6.0
Addition to retained earnings	$ 4.0

Balance Sheet

Assets			Liabilities and Stockholders' Equity		
		Projected % of Sales			Projected % of Sales
Assets	$50.0	50.0%	Total debt	$20.0	n/a
			Equity	30.0	n/a
Total assets	$50.0		Total liabilities and stockholders' equity	$50.0	

EXHIBIT 19.10 **Empire Enterprises: Pro Forma Income Statement and Balance Sheet ($ millions)**

The pro forma balance sheet for Empire Enterprises does not balance, and the difference is the amount of EFN. Because the company's board does not wish to issue common stock, the funding will have to take the form of long-term debt.

Income Statement (Pro Forma)

Net sales	$120.0
Costs	180.0
Net income	$ 12.0
Dividends	$ 7.2
Addition to retained earnings	$ 4.8

Balance Sheet (Pro Forma)

Assets	Projected	Change	Liabilities and Stockholders' Equity	Projected	Change
Assets	$60.0	$10.0	Total debt	$20.0	$0.0
			Equity	34.8	4.8
Total assets	$60.0	$10.0	Total liabilities and stockholders' equity	$54.8	$4.8
			External funding needed (EFN)	$ 5.2	

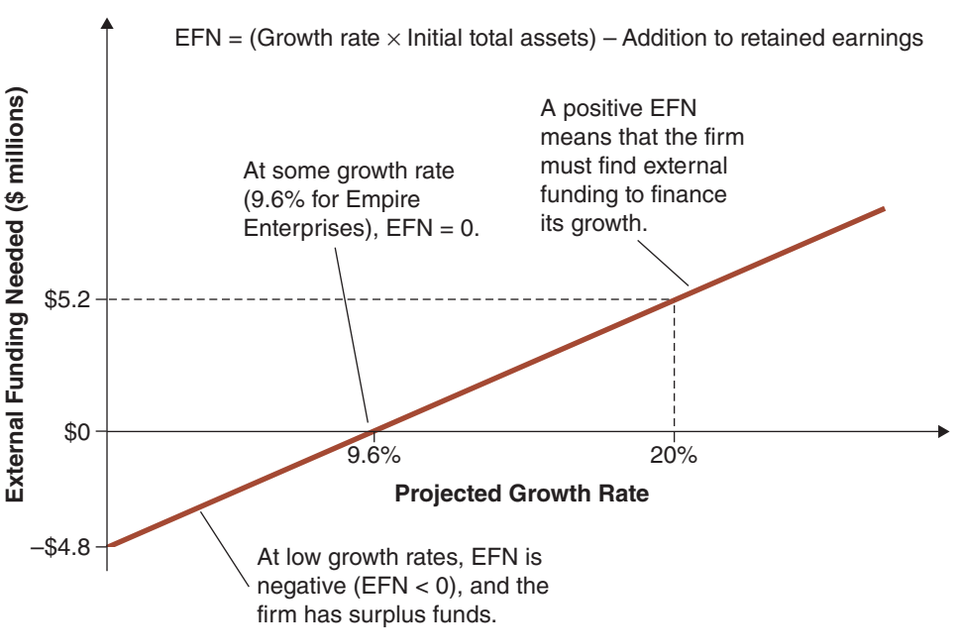


EXHIBIT 19.11 **External Funding Needed (EFN) and Growth for Empire Enterprises**

The exhibit graphically illustrates Equation 19.6, showing the connection between growth rate in sales and EFN. The horizontal axis plots the firm's projected growth rate, and the vertical axis plots EFN. The upward slope of the line illustrates how external funding increases with the growth rate, assuming that the dividend policy is held constant.

DECISION MAKING

EXAMPLE 19.2 | Empire's Ambitious Growth Plan

Situation You are part of the Empire Enterprises finance team. The firm's strategic plan calls for revenues to grow at 20 percent next year. As mentioned, the board of directors is not interested in using any external equity funding. Some members of the team question whether these goals are realistic.

You have just been asked to comment on the proposed growth plan at a meeting. You have a little over an hour to prepare. During the time available, you completed the following calculations using data from the most recent and the pro forma income statements and balance sheets (Exhibits 19.9 and 19.10):

- EFN = (Growth rate × Initial total assets) − Addition to retained earnings = (0.20 × $50 million) − $4.8 million = $5.2 million
- IGR = Addition to retained earnings/Initial assets = $4.8 million/$50 million = 0.96, or 9.6%
- SGR = Plowback ratio × ROE = 0.40 × 0.333 = 13.3%

Given the above information, what can you say about this ambitious growth plan?

Decision You begin by applauding the visionary nature of the strategic plan. Clearly, you want to keep your job. You point out, however, that the firm is facing some challenges. First, Empire's IGR is 9.6 percent, which is the maximum growth rate the firm can achieve without any kind of external funding. This amount is substantially below the desired growth rate of 20 percent. Second, you note that Empire's EFN is $5.2 million. This means that $5.2 million of external capital will have to be raised by selling equity, debt, or some combination of the two. Finally, Empire's SGR is 13.3 percent—also below the 20 percent growth target. Empire cannot grow more than 13.3 percent without selling equity if management wants to keep the firm's capital structure at its current level.

LEARNING BY DOING

APPLICATION 19.3 | Sustainable Growth and Financial Statements

Problem Because of your presentation (see Decision Making Example 19.2), Empire's top management team has had second thoughts about its goal of growing the firm 20 percent during the next year. As a result, you must prepare pro forma financial statements at a sales growth rate equal to the firm's SGR of 13.3 percent.

Approach For the income statement, all costs grow at the same rate as revenues. Thus, you can multiply the current period's net sales and costs by 1.133 to calculate the projected values of sales and costs. To construct the balance sheet, you must first compute the values of accounts that vary with net sales. Since you have no information about how much of Empire's total debt is long-term debt, you should enter its total debt value of $20 million, along with all the information you have on the balance sheet accounts. Finally, to make the balance sheet balance, you should calculate the amount of EFN.

Solution

Net sales = $100 million × 1.133 = $113.30 million
Costs = $90 million × 1.133 = $101.97 million

The income statement is:

Empire Enterprises Pro Forma Income Statement ($ millions)	
Net sales	$113.30
Costs	101.97
Net income	$ 11.33

Dividend = Net income × Payout ratio = $11.33 million × 0.60 = $6.80 million

Addition to retained earnings = Net income × Plowback ratio = $11.33 million × 0.40
= $4.53 million

Forecast value of the assets: \$50 million × 1.133 = \$56.65 million

Value of the equity: \$30 million + \$4.53 million = \$34.53 million, where \$30 million is the initial value and \$4.53 million is the addition to retained earnings

Value of debt plus equity: \$20 million + 34.53 million = \$54.53 million

The balance sheet does not balance (\$56.65 million assets > \$54.53 million debt plus equity), and the difference (\$2.12 million) is the plug number, which is the EFN. Thus, to achieve the 13.3 percent rate of growth, Empire will need to issue \$2.12 million in long-term debt, which will bring the debt account to \$20 million + \$2.12 million = \$22.12 million. The resulting balance sheet is as follows:

Empire Enterprises Pro Forma Balance Sheet (\$ millions)

Assets		Liabilities and Stockholders' Equity	
Assets	\$56.65	Total debt	\$22.12
		Equity	34.53
Total assets	\$56.65	Total liabilities and stockholders' equity	\$56.65

Summary of Key Equations

Equation	Description	Formula
19.1	Percent change in sales	$\%\Delta S = \frac{(S_{t+1} - S_t)}{S_t}$
19.2	Percent of net income paid out as dividends	$\text{Dividend payout ratio} = \frac{\text{Cash dividends}}{\text{Net income}}$
19.3	Percent of net income retained (plowed back into the firm)	$\text{Retention (plowback) ratio} = \frac{\text{Addition to retained earnings}}{\text{Net income}}$
19.4	Amount of assets needed to generate \$1 of sales	$\text{Capital intensity ratio} = \frac{\text{Total assets}}{\text{Net sales}}$
19.5 & 19.6	External funding needed to support growth in sales	$\text{EFN} = \text{New investments} - \text{Addition to retained earnings}$ $= (\text{Growth rate} \times \text{Initial total assets}) - \text{Addition to retained earnings}$
19.7 & 19.8	Internal growth rate (level of growth that can be supported without raising external funds)	$\text{IGR} = \frac{\text{Addition to retained earnings}}{\text{Initial total assets}}$ $= \text{Plowback ratio} \times \text{Return on equity} \times \text{Measure of leverage}$
19.9	Sustainable growth rate (level of growth that can be supported without raising external equity or increasing current leverage)	$\text{SGR} = \text{Plowback ratio} \times \text{ROE}$

Self-Study Problems

19.1 The Starlight, Inc., financial statements for the fiscal year ended June 30, 2017, are presented below. The firm's sales are projected to grow at a rate of 20 percent next year, and all financial statement accounts will vary directly with sales. Based on that projection, develop a pro forma balance sheet and income statement for the fiscal year ending June 30, 2018.

Starlight, Inc., Balance Sheet as of June 30, 2017

Assets:		Liabilities and Stockholders' Equity:	
Cash	$ 25,135	Accounts payable	$ 67,855
Accounts receivable	43,758	Notes payable	36,454
Inventories	167,112		
Total current assets	$236,005	Total current liabilities	$104,309
Net fixed assets	325,422	Long-term debt	223,125
Other assets	13,125	Common stock	150,000
		Retained earnings	97,118
Total assets	$574,552	Total liabilities and equity	$574,552

Starlight, Inc., Income Statement for the Fiscal Year Ended June 30, 2017

Net sales	$1,450,000
Costs	812,500
EBITDA	$ 637,500
Depreciation	175,000
EBIT	$ 462,500
Interest	89,575
EBT	$ 372,925
Taxes (35%)	130,524
Net income	$ 242,401

19.2 Use the financial information for Starlight from Self-Study Problem 19.1. Assume now that equity accounts do not vary directly with sales but change when retained earnings change or new equity is issued. The company pays 45 percent of its income as dividends every year. In addition, the company plans to expand production capacity by building a new facility that will cost $225,000. The firm has no plans to issue new equity this year and any funds that need to be raised will be raised through the sale of long-term debt. Prepare a pro forma balance sheet using this information.

19.3 Use the financial statements from Self-Study Problem 19.1 and the information from Self-Study Problem 19.2 to calculate the company's retention (plowback) ratio, external funds needed (EFN), internal growth rate (IGR), and sustainable growth rate (SGR).

19.4 Northwood Corp. has a dividend payout ratio of 60 percent, return on equity of 14.5 percent, total assets of $11,500,450, and equity of $4,652,125. Calculate the firm's internal rate of growth (IGR).

19.5 Renewal Company has net income of $1.25 million and a dividend payout ratio of 35 percent. It currently has equity of $2,875,223. What is the firm's sustainable growth rate (SGR)?

Solutions to Self-Study Problems

19.1 The pro forma statements for Starlight are as follows:

Starlight, Inc., Balance Sheet as of June 30, 2018			
Assets:		Liabilities and Stockholders' Equity:	
Cash	$ 30,162	Accounts payable	$ 81,426
Accounts receivable	52,510	Notes payable	43,754
Inventories	200,534		
Total current assets	$283,206	Total current liabilities	$125,171
Net fixed assets	390,506	Long-term debt	267,750
Other assets	15,750	Common stock	180,000
		Retained earnings	116,542
Total assets	$689,462	Total liabilities and equity	$689,462

Starlight, Inc., Income Statement for the Fiscal Year Ended June 30, 2018	
Net sales	$1,740,000
Costs	975,000
EBITDA	$ 765,000
Depreciation	210,000
EBIT	$ 555,000
Interest	107,490
EBT	$ 447,510
Taxes (35%)	156,629
Net income	$ 290,882

19.2 The pro forma income statement is the same as that shown in the solution to Self-Study Problem 19.1. We now have to account for the payment of dividends. Since the company pays 45 percent of its net income as dividends, the retained earnings for 2018 is calculated as follows:

Retained earnings from 2018 income = $290,882 × (1 − 0.45) = $159,985.

- This is the amount by which retained earnings will increase in 2018, from $97,118 to $257,103.
- No new equity is added.
- The increase in assets is financed externally through the sale of long-term debt.

The pro forma balance sheet is as follows:

Starlight, Inc., Balance Sheet as of June 30, 2018			
Assets:		Liabilities and Stockholders' Equity:	
Cash	$ 30,162	Accounts payable	$ 81,426
Accounts receivable	52,510	Notes payable	43,754
Inventories	200,534		
Total current assets	$283,206	Total current liabilities	$125,171
Net fixed assets	390,506	Long-term debt	382,188
Addition to fixed assets	225,000	Common stock	150,000
Other assets	15,750	Retained earnings	257,103
Total assets	$914,462	Total liabilities and equity	$914,462

19.3 The retention (plowback) ratio, external funds needed, internal growth rate, and sustainable growth rate are calculated as follows:

$$\text{Retention ratio} = \frac{\text{Addition to retained earnings}}{\text{Net income}}$$

$$= \frac{\$159{,}985}{\$290{,}882}$$

$$= 0.55, \text{ or } 55\%$$

$$\begin{aligned}\text{EFN} &= (\text{Growth rate} \times \text{Initial total assets}) - \text{Addition to retained earnings}\\ &= (0.20 \times \$574{,}552) - \$159{,}985\\ &= -\$45{,}075\end{aligned}$$

Thus, without considering the investment of $225,000 for the new facility, the firm will not need any external funding. However, if you add the investment, then,

$$\begin{aligned}\text{EFN} &= \text{New investments} - \text{Addition to retained earnings}\\ &= (0.20 \times \$574{,}552) + \$225{,}000 - \$159{,}985\\ &= \$179{,}925\end{aligned}$$

$$\begin{aligned}\text{IGR} &= \frac{\text{Addition to retained earnings}}{\text{Initial total assets}}\\ &= \frac{\$159{,}985}{\$574{,}552}\\ &= 0.278, \text{ or } 27.8\%\end{aligned}$$

$$\begin{aligned}\text{SGR} &= \text{Plowback ratio} \times \text{ROE}\\ &= \frac{\text{Addition to retained earnings}}{\text{Net income}} \times \frac{\text{Net income}}{\text{Total equity}}\\ &= 0.55 \times 0.715\\ &= 0.393, \text{ or } 39.3\%\end{aligned}$$

19.4 We calculate Northwood's internal growth rate as follows:

$$\begin{aligned}\text{IGR} &= \text{Plowback ratio} \times \text{ROE} \times \text{Measure of leverage}\\ &= 0.40 \times 0.145 \times \frac{\$4{,}652{,}125}{\$11{,}500{,}450}\\ &= 0.0235, \text{ or } 2.35\%\end{aligned}$$

19.5 Renewal's sustainable growth rate is:

$$\begin{aligned}\text{SGR} &= \text{Plowback ratio} \times \text{ROE}\\ &= 0.65 \times \frac{\$1{,}250{,}000}{\$2{,}875{,}223}\\ &= 0.283 = 28.3\%\end{aligned}$$

Discussion Questions

19.1 What is financial planning? What four types of plans/budgets are involved in financial planning?

19.2 Why is the capital budget an important part of a firm's financial planning?

19.3 Why do financing and investment decisions have to be made concurrently?

19.4 Explain how sales can be used to develop pro forma financial statements.

19.5 Why is sales not always a good measure to use in forecasting fixed assets?

19.6 List all the accounts that can be affected by the "plug" value. How does this value help managers?

19.7 Explain why the fixed asset account may or may not vary with sales.

19.8 How does the dividend payout ratio affect the amount of funds needed to finance growth?

19.9 Define internal growth rate (IGR). Identify the characteristics of a high-growth firm that has no external funds needed.

19.10 What is the sustainable growth rate (SGR)? Why is it important?

Questions and Problems

Basic

19.1 **Strategic plan:** Explain the importance of the strategic plan.

19.2 **Capital budget:** What are the various steps in preparing a capital budget?

19.3 **Financing plan:** What are the elements of a financing plan?

19.4 **Financial planning:** Identify the steps in the financial planning process.

19.5 **Financial modeling:** List the various elements of financial modeling.

19.6 **Payout ratio:** Define the retention (plowback) ratio and the dividend payout ratio.

19.7 **Addition to retained earnings:** Northwood, Inc., has revenue of $455,316, costs of $316,487, and a tax rate of 31 percent. If the firm pays out 45 percent of its earnings as dividends every year, how much earnings are retained and what is the firm's retention ratio?

19.8 **Payout and retention ratio:** Goodwin Corp. has revenues of $12,112,659, costs of $9,080,545, interest payments of $412,375, and a tax rate of 34 percent. It paid dividends of $1,025,000 to its stockholders. What are the firm's dividend payout ratio and retention ratio?

19.9 **Percent of sales:** Cattail Corporation's financial statements for the fiscal year just ended are shown below:

Cattail Corporation
Financial Statements for Fiscal Year Just Ended
($ thousands)

Income Statement		Balance Sheet			
Net sales	$1,500	Assets	$700	Debt	$600
Costs	350			Equity	100
Net income	$1,150	Total	$700	Total	$700

Cattail management expects sales to increase by 14 percent next year. Assume that the financial statement accounts vary directly with changes in sales and that management has no financing plan at this time. Given this information, develop a pro forma income statement for Cattail for the next fiscal year.

19.10 **Percent of sales:** Given the data for Cattail Corporation in Problem 19.9, if you assume that all balance sheet items also vary with the change in sales, develop a pro forma balance sheet for Cattail for the next fiscal year. Assuming that the firm did not sell or repurchase stock, what is the cash dividend implied by the pro forma income statement and balance sheet?

19.11 **Capital intensity ratio:** Define capital intensity ratio, and explain its significance.

19.12 **Capital intensity ratio:** Tantrix Confectioners has total assets of $3,257,845 and net sales of $5,123,951. What is the firm's capital intensity ratio?

19.13 **Capital intensity ratio:** McDonald Metal Works has been able to generate net sales of $13,445,196 on assets of $9,145,633. What is the firm's capital intensity ratio?

19.14 **Capital intensity ratio:** For McDonald Metal Works in Problem 19.13, how much must net sales grow if the capital intensity ratio has to drop to 60 percent? State your answer as both a percent of sales and a dollar sales increase.

19.15 **Internal growth rate:** Swan Supply Company has net income of $1,212,335, assets of $12,522,788, and retains 70 percent of its income every year. What is the company's internal growth rate?

19.16 **Sustainable growth rate:** If Newell Corp. has a ROE of 13.7 percent and a dividend payout ratio of 32 percent, what is its sustainable growth rate?

19.17 **EFN and growth:** Refer to Exhibits 19.10 and 19.11 in the text. The EFNs for several growth rates for Empire Enterprises are as follows:

Growth Rate (%)	EFN ($ millions)
0%	−$4.8
5	−2.3
9.6	0.0
10	0.2
15	2.7
20	5.2

Check the calculations and plot the line to replicate the graph in Exhibit 19.11.

Intermediate

19.18 Retention ratio: Refer to Problem 19.7. Northwood expects to increase its sales by 15 percent next year. All costs vary directly with sales. If Northwood wants to retain $65,000 of earnings next year, will it have to change its dividend payout ratio? If so, what will be the new dividend payout and retention ratios for the firm?

19.19 Capital intensity: Identify two industries (other than airlines) that are capital intensive. Using online or other data sources, compute the capital intensity ratio for the largest firm in each of the chosen industries.

19.20 Percent of sales: Tomey Supply Company's financial statements for the most recent fiscal year are shown below. Management projects that sales will increase by 20 percent next year. Assume that all costs and assets increase directly with sales. The company has a constant 33 percent dividend payout ratio and has no plans to issue new equity. Any financing needed will be raised through the sale of long-term debt. Prepare pro forma financial statements for the coming year based on this information, and calculate the EFN for Tomey.

Tomey Supply Company Income Statement and Balance Sheet

Income Statement		Balance Sheet	
Net sales	$1,768,121	Assets:	
Costs	1,116,487	Current assets	$280,754
EBT	$ 651,634	Net fixed assets	713,655
Taxes (35%)	228,072	Total assets	$994,409
Net income	$ 423,562		
		Liabilities and Equity:	
		Current liabilities	$167,326
		Long-term debt	319,456
		Common stock	200,000
		Retained earnings	307,627
		Total liabilities and equity	$994,409

19.21 Internal growth rate: Using the pro forma financial statements for Tomey Supply Company developed in Problem 19.20, find the internal growth rate for Tomey.

19.22 Sustainable growth rate: Use the following pro forma information for Tomey Supply Company for next year: net income = $508,275; addition to retained earnings = $340,544; common equity = $848,171; net sales = $2,121,745. Assume that management does not want the ratio of long-term debt to equity to exceed the current long-term debt-to-equity ratio of 63 percent and also does not want to issue new equity. What level of sales growth can Tomey Supply Company sustain? Calculate the new sales level.

19.23 Sustainable growth rate: Rowan Company has a net profit margin of 8.3 percent, debt ratio of 45 percent, total assets of $4,157,550, and sales of $6,852,654. If the company has a dividend payout ratio of 67 percent, what is its sustainable growth rate?

19.24 Sustainable growth rate: Refer to the information for Rowan Company in Problem 19.23. The firm's management desires a sustainable growth rate of 10 percent but does not wish to change the company's level of debt or its payout ratio. What will the firm's new net profit margin have to be in order to achieve the desired growth rate?

19.25 Sustainable growth rate: Rocky Sales, Inc., has current sales of $1,215,326 and net income of $211,253. It also has a debt ratio of 25 percent and a dividend payout ratio of 75 percent. The company's total assets are $712,455. What is its sustainable growth rate?

19.26 Sustainable growth rate: Ellicott Textile Mills management has reported the following financial information for the year ended September 30, 2017. The company generated a net income of $915,366 on a net profit margin of 6.4 percent. It has a dividend payout ratio of 50 percent, a capital intensity ratio of 62 percent, and a debt ratio of 45 percent. What is the company's sustainable growth rate?

19.27 Internal growth rate: Given the information in Problem 19.26, what is the internal growth rate of Ellicott Textile Mills?

19.28 Internal growth rate: Fantasy Travel Company has a return on equity of 17.5 percent, a total equity/total assets ratio of 65 percent, and a dividend payout ratio of 75 percent. What is the company's internal growth rate?

19.29 EFN: Maryland Micro Brewers generated revenues of $12,125,800 with a 72 percent capital intensity ratio during the year ended September 30, 2017. Its net income was $873,058. With the introduction of a half dozen new specialty beers, management expects to grow sales by 15 percent next year. Assume that all costs vary directly with sales and that the firm maintains a dividend payout ratio of 70 percent. What will be the EFN needed by this firm? If the company wants to raise no more than $750,000 externally and is not averse to adjusting its dividend payout policy, what will be the new dividend payout ratio?

19.30 EFN: Ritchie Marble Company has total assets of $12,899,450, sales of $18,174,652, and net income of $4,589,774. Management expects sales to grow by 25 percent next year. All assets and costs (including taxes) vary directly with sales, and management expects to maintain a payout ratio of 65 percent. Calculate Ritchie's EFN.

19.31 EFN: Norton Group, Inc., expects to add $1,213,777 to retained earnings and currently has total assets of $23,159,852. If the company has the ability to borrow up to $1 million, how much growth can the firm support if it is willing to borrow to its maximum capacity?

19.32 EFN: Capstone Marketing Group has total assets of $5,568,000, sales of $3,008,725, and net income of $822,000. The company expects its sales to grow by 12 percent next year. All assets and costs (including taxes) vary directly with sales, and the firm expects to maintain a payout ratio of 55 percent. Calculate Capstone's EFN.

19.33 Maximum sales growth: Given the data for Capstone Marketing Group in Problem 19.32, what would Capstone's payout ratio have to be for the firm's EFN to be zero?

19.34 Maximum sales growth: Rockville Consulting Group expects to add $271,898 to retained earnings this year. The company has total assets of $3,425,693 and wishes to add no new external funds for the coming year. If assets and costs vary directly with sales, how much sales growth can the company support while retaining an EFN of zero? What is the firm's internal growth rate?

Advanced

19.35 The financial statements for the year ended June 30, 2017, are given below for Morgan Construction Company. The firm's sales are projected to grow at a rate of 25 percent next year, and all financial statement accounts will vary directly with sales. Based on that projection, develop a pro forma balance sheet and an income statement for the 2018 fiscal year.

Morgan Construction Company Balance Sheet as of June 30, 2017

Assets:		Liabilities and Stockholders' Equity:	
Cash	$ 3,349,239	Accounts payable	$ 9,041,679
Accounts receivable	5,830,754	Notes payable	4,857,496
Inventories	22,267,674	Total current liabilities	$13,899,175
Total current assets	$31,447,667	Long-term debt	29,731,406
Net fixed assets	43,362,482	Common stock	19,987,500
Other assets	1,748,906	Retained earnings	12,940,974
Total assets	$76,559,055	Total liabilities and equity	$76,559,055

Morgan Construction Company Income Statement for the Fiscal Year Ended June 30, 2017

Net sales	$193,212,500
Costs	45,265,625
EBITDA	$ 47,946,875
Depreciation	23,318,750
EBIT	$ 24,628,125
Interest	11,935,869
EBT	$ 12,692,256
Taxes (35%)	4,442,290
Net income	$ 8,249,966

19.36 Use the financial information for Morgan Construction Company from Problem 19.35. Assume now that equity accounts do not vary directly with sales but change when retained earnings change or new equity is issued. The company pays 75 percent of its income as dividends every year. In addition, the company plans to expand production capacity by expanding the current facility and acquiring additional equipment. This will cost the firm $10 million. The firm has no plans to issue new equity this year. Prepare a pro forma balance sheet using this information. Any funds that need to be raised (in addition to changes in current liabilities) will be in the form of long-term debt. What is the external funding needed in this case?

19.37 Using the information for Morgan Construction Company in the preceding problem, calculate the firm's internal growth rate and sustainable growth rate.

19.38 Use the information for Morgan Construction Company from Problems 19.35 and 19.36. Assume that equity accounts do not vary directly with sales, but change when retained earnings change or new equity is issued. The company's long-term debt-to-equity ratio is approximately 90 percent, and its equity-to-total assets ratio is about 43 percent. The company management wishes to increase its equity-to-total assets ratio to at least 50 percent. Management is willing to reduce the company's payout ratio but will retain no more than 40 percent of earnings. The company will raise any additional funds needed, including funds for expansion, by selling new equity. No new long-term debt will be issued. Prepare pro forma statements to reflect this new scenario.

a. What is the external funding needed to accommodate the expected growth?

b. What is the firm's internal growth rate?

c. What is the firm's sustainable growth rate?

d. How much new equity will the firm have to issue?

e. What is the firm's new equity ratio and debt-to-equity ratio?

19.39 Munson Communications Company management has just reported earnings for the year ended June 30, 2017. Below are the firm's income statement and balance sheet. The company had a 55 percent dividend payout ratio for the last 10 years and management does not plan to change this policy. Based on internal forecasts, management expects sales growth in 2018 to be 20 percent. Assume that equity accounts and long-term debt do not vary directly with sales but change when retained earnings change or additional capital is issued.

Munson Communications Company Balance Sheet as of June 30, 2017

Assets:		Liabilities and Stockholders' Equity:	
Cash	$ 1,728,639	Accounts payable	$ 4,666,673
Accounts receivable	3,009,421	Notes payable	2,507,094
Inventories	11,492,993	Total current liabilities	$ 7,173,767
Total current assets	$16,231,054	Long-term debt	13,345,242
Net fixed assets	22,380,636	Common stock	10,165,235
Other assets	1,748,906	Retained earnings	9,676,351
Total assets	$40,360,595	Total liabilities and equity	$40,360,595

Munson Communications Company Income Statement for the Fiscal Year Ended June 30, 2017

Net sales	$79,722,581
Costs	59,358,499
EBITDA	$20,364,082
Depreciation	7,318,750
EBIT	$13,045,332
Interest	3,658,477
EBT	$ 9,386,855
Taxes (35%)	3,285,399
Net income	$ 6,101,456

a. What is the firm's internal growth rate (IGR)?

b. What is the firm's sustainable growth rate (SGR)?

c. What is the external funding needed (EFN) to accommodate the expected growth?

d. Construct the firm's 2018 pro forma financial statements under the assumption that long-term debt will provide all external funding.

Sample Test Problems

19.1 Mars Company had net sales of $18 million in the year that just ended. Next year, the company's management expects a 15 percent increase in sales. If cost of goods sold is 60 percent of sales and inventory is 25 percent of sales, what would you estimate sales, inventory, and cost of goods sold to be next year?

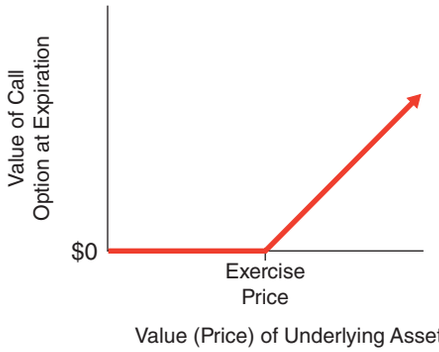
19.2 Lavaca Inc. management expects net sales to be $855,000, total costs to be $647,000, and to pay taxes at an average rate of 32 percent this year. If Lavaca pays out 38 percent of its earnings as dividends, what is its retention ratio? How much will Lavaca's retained earnings increase?

19.3 Spurlock Inc. had net income of $266,778 in its most recent fiscal year and total assets of $1,833,400 at the end of the year. The company's total debt ratio (total debt to total assets) is 35 percent, and Spurlock retains 60 percent of its income every year. What is Spurlock's internal growth rate? What is its sustainable growth rate?

19.4 Using the information in Sample Test Problem 19.3, what is Spurlock's capital intensity ratio if the company has net sales of $3,557,100? What does this ratio tell us?

19.5 Edgefield Excavation Company has total assets of $4,976,456, sales of $1,225,700, and net income of $587,000. The company's management expects sales to grow by 9 percent next year. All costs (including taxes) and assets vary directly with sales, and the firm expects to maintain a payout ratio of 35 percent. Calculate the external funds needed (EFN) by Edgefield. What would Edgefield's payout ratio have to be in order for the company's EFN to equal zero?

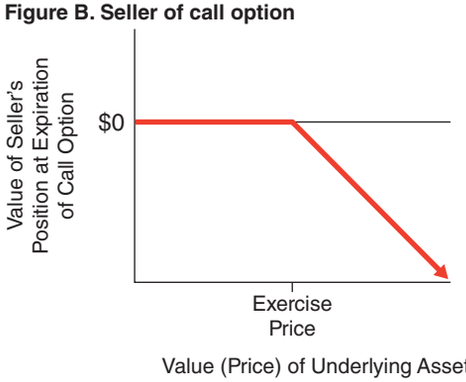
Figure A. Owner (buyer) of a call option



The value of a call option *increases* dollar for dollar with an *increase* in the value of the underlying asset when the value of that asset is above the exercise price.

At the instant before it expires, the value of a call option to the owner equals either (1) $0, if the value of the underlying asset is less than or equal to the exercise price, or (2) the value of the underlying asset minus the exercise price, if the value of the underlying asset is greater.

Figure B. Seller of call option



The value of the seller's position *decreases* dollar for dollar with an *increase* in the value of the underlying asset when the value of that asset is above the exercise price of a call option.

The value of the seller's position equals either (1) $0 if the value of the underlying asset is less than or equal to the exercise price or (2) the exercise price minus the value of the underlying asset if the value of the underlying asset is greater.

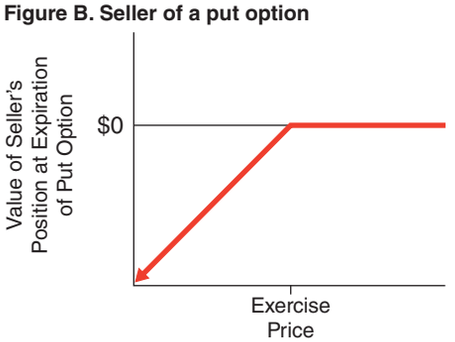
EXHIBIT 20.1 **Payoff Functions for a Call Option at Expiration**

Figure A. Owner (buyer) of a put option

The value of an expiring put option *increases* dollar for dollar with a *decrease* in the value of the underlying asset when the value of that asset is below the exercise price.

At the instant before it expires, the value of a put option to the owner equals either (1) $0, if the value of the underlying asset is greater than or equal to the exercise price, or (2) the exercise price minus the value of the underlying asset, if the value of the underlying asset is less than the exercise price.

Figure B. Seller of a put option



The value of the seller's position *decreases* dollar for dollar with a *decrease* in the value of the underlying asset, when the value of that asset is below the exercise price of a put option.

The value to the seller of a put option equals either (1) $0, if the value of the underlying asset is greater than or equal to the exercise price, or (2) the value of the underlying asset minus the exercise price, if the value of the underlying asset is smaller than the exercise price.

EXHIBIT 20.2 **Payoff Functions for Put Option at Expiration**

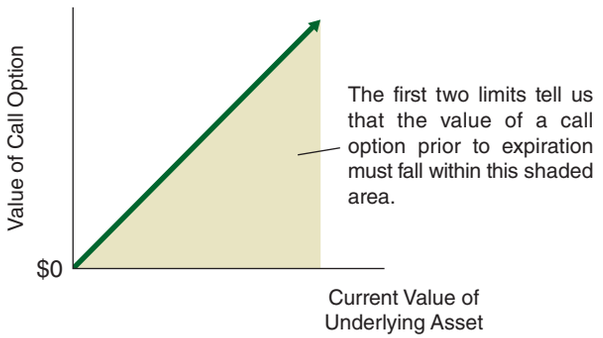
EXAMPLE 20.1 | When It Makes Sense to Exercise an Option

DECISION MAKING

Situation You own a call option and a put option on a share of Ford Motor Company stock. The exercise price for both of these options is $18 per share, and both options expire today. If the current price of Ford stock is $17, would you exercise either of these options? If so, which one?

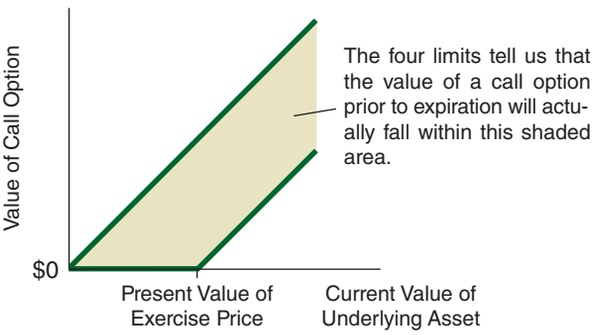
Decision You should exercise the put option. It allows you to sell a share of Ford stock for $18 that would cost you only $17 to buy. It does not make sense to exercise the call option because the exercise price is greater than the market price of Ford stock.

Figure A. Possible values with first two limits



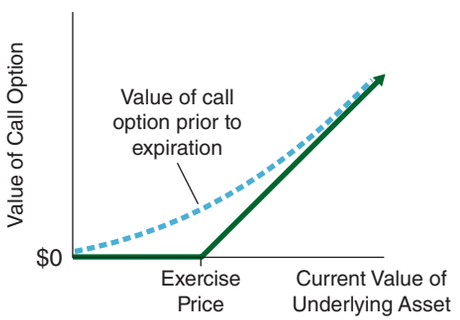
The value of a call option: (1) must be greater than or equal to $0 (horizontal axis) and (2) cannot be greater than the value of the underlying asset (45 degree line).

Figure B. Possible values with all four limits



In addition to the two limits illustrated in Figure A, the value of a call option prior to expiration: (3) will never be less than the value of the option if it were exercised immediately where (4) the value of the option is calculated using the present value of the exercise price, discounted from the expiration date at the risk-free rate. These conditions are both illustrated by the lower 45, degree line.

Figure C. Typical payoff function for call option prior to expiration



This figure shows the typical relation between the value of a call option prior to expiration and its value at expiration. The value of the option prior to expiration is farthest from the value of the option at expiration when the value of the underlying asset is near the exercise price.

EXHIBIT 20.3 **Possible Values of a Call Option Prior to Expiration**

Figure 20.1

$$\sigma_{2\text{ years}} = \sigma_{1\text{ year}} \times (n)^{1/2} = 30\% \times (2\text{ years})^{1/2} = 30\% \times 1.414 = 42.42\%$$

The Binomial Option Pricing Model

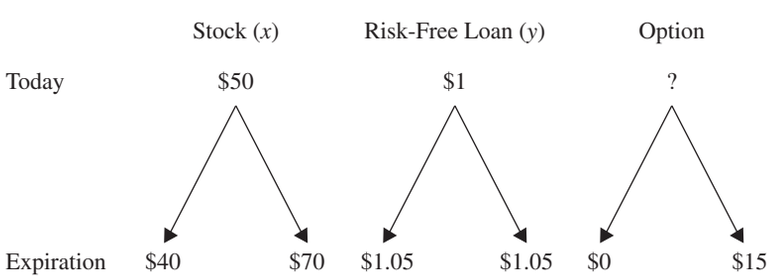
In this section, we use a simple model to show how we can calculate the value of a call option at some point before the expiration date. This model assumes that the underlying asset will have one of only two possible values when the option expires. The value of the underlying asset will either increase to some value above the exercise price or decrease to some value below the exercise price.

To solve for the value of the call option using this model, we must assume that investors have no arbitrage opportunities with regard to this option. **Arbitrage** is the act of buying and selling assets in a way that yields a return above that suggested by the Security Market Line (SML), which we discussed in Chapter 7. In other words, the absence of arbitrage opportunities means that investors cannot earn a return that is greater than that justified by the systematic risk associated with an investment. As an example of an arbitrage opportunity, suppose that the stock of a particular company is being sold for a lower price in one country than in another country. An investor could simultaneously buy the stock in the country where it is less expensive and sell it in the country where it is more expensive. Assuming that the profit exceeds any transaction costs, the investor would earn an instantaneous risk-free profit. Since it is instantaneous, this profit would, by definition, be above the SML because the SML would predict that the expected return on a risk-free investment is zero if the holding period is zero.

To value the call option in our simple model, we will first create a portfolio that consists of the asset underlying the call option and a risk-free loan. The relative investments in these two assets will be selected so that the combination of the asset and the loan have the same cash flows as the call option, regardless of whether the value of the underlying asset goes up or down. This is called a *replicating portfolio*, since it replicates the cash flows of the option. The replicating portfolio must have the same value as the option today, since it has the same cash flows as the call option in all possible future outcomes. If the replicating portfolio did not have the same value as the option, an investor could construct an arbitrage portfolio by buying the cheaper of the two and selling the more expensive of the two. Such trading would eventually drive the values of the option and the replicating portfolio together.

To see how a replicating portfolio is constructed, consider an example. Suppose that the stock of ABC Corporation currently trades for $50 and that its price will be either $70 or $40 in one year. We want to determine the value of a call option to buy ABC stock for $55 in one year. First, notice that the value of this option is $15 if the stock price goes up to $70 ($70 − $55 = $15) and that it is $0 if the stock price goes down to $40, since the option will not be exercised. Suppose also that the risk-free rate is 5 percent.

We can construct a portfolio consisting of x shares of ABC Corporation stock and a risk-free loan with a value of y dollars that produces a payoff of either $70 or $40. The risk-free loan may involve either borrowing or lending, as you will see. For each risk-free dollar we lend, we know that we will receive $1.05 regardless of what happens to the price of ABC stock. In the same way, if we borrow $1, we will owe $1.05 at the end of the year. The value of the stock, the risk-free loan, and the option today and at expiration can be illustrated as follows.



The value of each asset when the stock price goes up to $70 is shown on the right arrow, and the value when the stock goes down to $40 is shown on the left arrow. Notice that we do not know the value of the option today—that is what we are trying to calculate.

We can write two equations that define the replicating portfolio that we want to construct:

$$\$15 = (\$70 \times x) + (1.05 \times y)$$
$$\$0 = (\$40 \times x) + (1.05 \times y)$$

The first equation represents the case in which the stock price increases to $70, and the second equation represents the case in which the stock price goes down to $40. The first equation says that we want the portfolio to be worth $15 when the stock price increases to $70 and that the $15 value will consist of x shares of stock worth $70 and a risk-free loan with a face value of y and a value in one year of $1.05 per dollar of face value. Similarly, the second equation says that if the stock price falls to $40, we want the portfolio to be worth $0. In this case, the portfolio will consist of x shares of stock worth $40 and a risk-free loan with a face value of y and a value in one year of $1.05 per dollar of face value.

Since we have two equations and there are two unknowns, x and y, we can solve for the values of the unknowns. Recall from your algebra class that we can solve for x and y by first writing one equation in terms of either x or y and then substituting the result into the second equation. For example, the first equation can be written in terms of x as follows:

$$x = \frac{\$15 - (1.05 \times y)}{\$70}$$

Now, substituting into the second equation gives us:

$$\$0 = \left(\$40 \times \frac{\$15 - (1.05 \times y)}{\$70}\right) + (1.05 \times y)$$

We can now solve this equation for y as follows:

$$\$0 = \left(\$40 \times \frac{\$15}{\$70}\right) - \left(\$40 \times \frac{1.05 \times y}{\$70}\right) + (1.05 \times y)$$

$$\$0 = \$8.5714 - (0.6 \times y) + (1.05 \times y)$$

$$\$0 = \$8.5714 + 0.45y$$

$$0.45y = -\$8.5714$$

Therefore:

$$y = \frac{-\$8.5714}{0.45} = -\$19.05$$

Finally, substituting this value back into the first equation gives us the value of x:

$$x = \frac{\$15 - (1.05 \times -\$19.05)}{\$70}$$

$$x = \frac{\$15 + \$20.00}{\$70}$$

$$x = 0.5$$

This tells us that the replicating portfolio consists of one-half share of ABC Corporation stock ($x = 0.50$) and a \$19.05 risk-free loan ($y = -\$19.05$). The negative value for y tells us that we would borrow, rather than lend, \$19.05 at the risk-free rate. If we buy one-half share of stock and borrow \$19.05, then in one year our replicating portfolio will have exactly the same payoff as the call option with an exercise price of \$55.

If the value of the stock declined to \$40, we would own one-half share of stock worth \$20, and we would owe $\$19.05 \times 1.05 = \$20$ on the loan. Since the value of the stock would exactly equal the amount owed on the loan, the portfolio would have a total value of exactly \$0. In contrast, if the value of the stock increased to \$70, the one-half share of stock would be worth \$35. Since we would still owe only \$20 in this case, the portfolio would have a total value of \$15. Since these payoffs are exactly the same as those for the option, this portfolio must have the same value as the option.

At this point, we know what the replicating portfolio consists of, and we know that the replicating portfolio must have the same value as the call option. Now all we have to do to estimate the value of the call option is to figure out what the value of the replicating portfolio is. To do this, we simply determine how much of our own money we would actually have to invest to construct the replicating portfolio. In our example, we could use the \$19.05 loan to help purchase the stock, so we would not have to come up with all the money for the stock on our own. In fact, since a share of ABC Corporation stock is currently worth \$50, one-half share of this stock would cost only \$25. Therefore, we would have to come up with only \$5.95 ($\$25.00 - \$19.05 = \$5.95$) over and above the amount received from the loan to buy the stock. Since \$5.95 is the amount of money that we would actually have to invest to obtain the replicating portfolio, it is the value of this portfolio and therefore the value of the call option.

The equation for calculating the value of the replicating portfolio, and therefore the value of the call option, can be expressed as follows:

$$\begin{aligned}\text{Value of the call option today} = C &= (\$50 \times x) + (1 \times y)\\ &= (\$50 \times 0.5) + (1 \times -\$19.05)\\ &= \$5.95\end{aligned}$$

Notice, too, that the exercise price, the current price of the underlying stock, the possible future prices of the underlying stock, and the risk-free rate are all that entered into our calculations. We did not even mention the probabilities that the stock price would go up or down at any point. That is because the volatility of the underlying stock value is accounted for by how far apart the two possible future values are. Similarly, the time to expiration is not directly considered. However, the time to expiration affects how high and how low the stock price can be when the option expires.

This model may seem surprisingly simple. However, that is largely because we chose to illustrate a simple example. The model can be extended in several ways. For example, we can incorporate possible prices for the underlying asset between now and the expiration date of the option. The underlying asset price might take one of two values one month (or day or hour) from now, and then for each of those values there might be two possible values in the following month (day or hour), and so on. Solving a model such as this requires us to work backwards from the expiration date to find the value of the option at each intermediate date and price until we finally arrive at the value of the option today. Most modern option pricing models are extensions of this type of model.

Learning by Doing Application 20.1 illustrates another example of a call option valuation.

$$P = C + Xe^{-rt} - V \qquad (20.1)$$

LEARNING BY DOING

APPLICATION 20.1 | Valuing a Call Option

Problem You are considering purchasing a call option on the stock of Grote Agricultural Company. Grote stock currently trades for $35 per share, and you predict that its price will be either $25 or $50 in one year. The call option would enable you to buy a share of Grote stock in one year for $30. What is this option worth if the risk-free rate is 4 percent?

Approach The value of the option can be determined by computing the cost of constructing a portfolio that replicates the payoffs from that option.

Solution With an exercise price of $30, the option will be worth $20 if the stock price rises to $50 ($50 − $30 = $20) and will be worth $0 if the stock price declines to $25. Therefore, the replicating portfolio for this option can be determined from the following two equations:

$$\$20 = (\$50 \times x) + (1.04 \times y)$$
$$\$0 = (\$25 \times x) + (1.04 \times y)$$

Solving for x and y, we find that $x = 0.80$ and $y = -\$19.23$. Therefore, the replicating portfolio consists of 0.8 share of Grote stock and a $19.23 loan. Since a 0.8 share would cost $28 ($0.8 \times \$35 = \$28$), and $19.23 of this amount would be covered by the loan, this replicating portfolio would cost $8.77 ($28.00 − $19.23 = $8.77) to construct. Therefore, the call option is worth $8.77.

APPLICATION 20.2 | Valuing a Put Option

LEARNING BY DOING

Problem In Learning by Doing Application 20.1, we found that a call option on a share of Grote Agricultural Company stock is worth $8.77 when the stock price is $35, the exercise price is $30, the risk-free rate is 4 percent, and the time to maturity is one year. What is the value of a put option on a share of this stock if the exercise price and all other variables have the same values?

Approach Use the put-call parity relation, Equation 20.1, to calculate the value of a put option.

Solution The value of the put option is as follows:

$$\begin{aligned} P &= C + Xe^{-rt} - V \\ &= \$8.77 + \$30e^{-(0.04)(1)} - \$35 \\ &= \$8.77 + \$28.82 - \$35 \\ &= \$2.59 \end{aligned}$$

Note that the value of the put option is less than the value of the call option in this example. This is because the current price of the stock is above the exercise price.

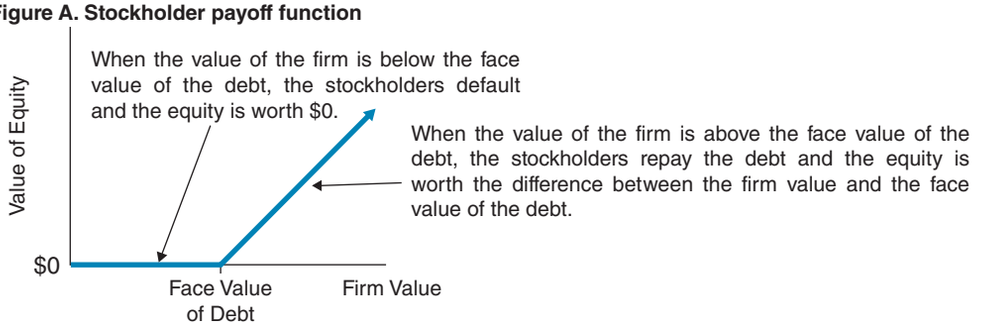
DECISION MAKING

EXAMPLE 20.2 | The Value of Real Options

Situation You work for a company that manufactures cardboard packaging for consumer product companies under long-term contracts. For example, your company manufactures the boxes for several popular cereal and aspirin products. You have just won a large five-year contract to produce packaging materials for a company that sells furniture on the Internet. Since this contract will require you to produce much larger boxes than you currently can produce, you must purchase some new equipment. You have narrowed your choices to two alternatives. The first is a capital-intensive process that will cost more up front, but will be less expensive to operate. This process requires very specialized equipment that can be used only for the type of packaging that your furniture client needs. The second alternative is a labor-intensive process that will require a smaller up-front investment, but will have higher unit costs. This process involves equipment that can be used to produce a wide range of other packages. If the expected life of both alternatives is 10 years and you estimate the NPV to be the same for both, which should you choose?

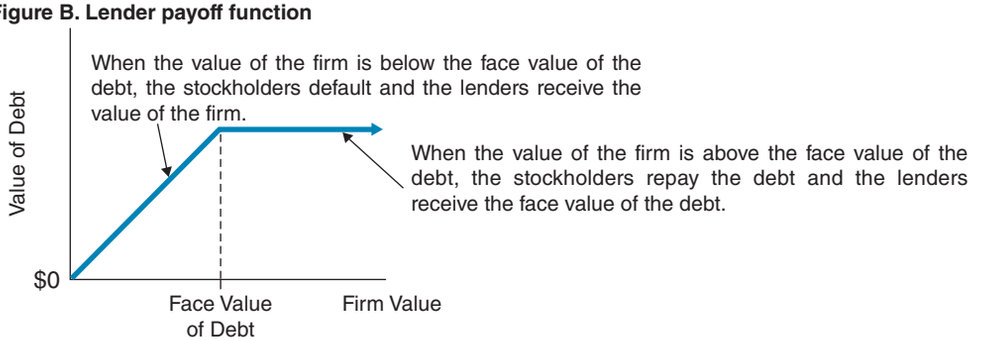
Decision You should choose the labor-intensive alternative. Your contract is only for five years, and there is a chance that it will not be renewed before the equipment's useful life is over. If the contract is not renewed, it will be easier to convert the labor-intensive equipment to another use. In other words, the labor-intensive alternative gives you the added value of having the option to abandon producing packaging for furniture.

Figure A. Stockholder payoff function



The equity in a leveraged corporation is like a call option on the underlying assets of the firm. The stockholders exercise their option by paying off the debt if the firm is worth more than the face value of the debt when the debt matures. If the value of the firm is lower than the face value of the debt, the stockholders can default (let their option expire) without incurring losses beyond their investment in the firm.

Figure B. Lender payoff function



The lenders' payoff function is like that for the seller of a put option. They have effectively agreed to purchase the firm for an amount that equals the face value of the firm's debt, at the discretion of the stockholders.

EXHIBIT 20.4 **Payoff Functions for Stockholders and Lenders**

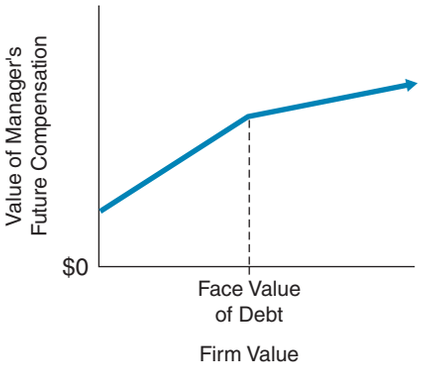


EXHIBIT 20.5 Representative Payoff Function for a Manager

The payoff function for a manager with a typical compensation arrangement is more similar in shape to the payoff function for a lender than for a stockholder. While a stockholder's payoff function is flat to the left of the face value of the debt, the value of the manager's compensation is downward sloping, much like the payoff for a lender. When the value of the firm is greater than the face value of the debt, the value of the manager's compensation does not increase as much as the value of the firm's shares (the line in the payoff function is not as steep). Because managers' payoff functions differ from those for stockholders, managers have incentives to take actions that are not in the best interests of stockholders.

Summary of Key Equations

Equation	Description	Formula
20.1	Put-call parity	$P = C + Xe^{-rt} - V$

Self-Study Problems

20.1 Of the two parties to an option contract, the buyer and the seller, who has a right and who has an obligation?

20.2 The stock of Augusta Light and Power is currently selling at $12 per share. Over the next year the company is undertaking a new electricity production project. If the project is successful, the company's stock is expected to rise to $24 per share. If the project fails, the stock is expected to fall to $8 per share. The risk free rate is 6 percent. Calculate the value today of a one year call option on one share of Augusta Light and Power with an exercise price of $20.

20.3 ADCAP International is a U.S.-based company that sells its products primarily in overseas markets. The company's stock is currently trading at $50 per share. Depending on the outcome of U.S. trade negotiations with the countries to which ADCAP exports its products, the company's stock price is expected to be either $65 or $30 in six months. The risk free rate is 8 percent per year. What is the value of a put option on ADCAP stock that has an exercise price of $40 per share?

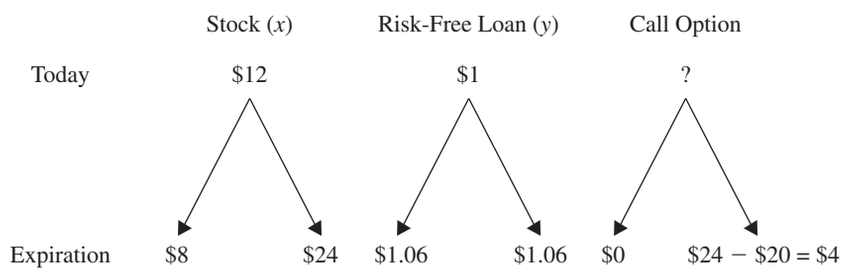
20.4 Your company is considering opening a new factory in Europe to serve the growing demand for your product there. What real options might you want to consider in your capital budgeting analysis of the factory?

20.5 Your firm, which uses oil as an input to its production processes, hedges its exposure to changes in the price of oil by buying call options on oil at today's price. If the price of oil goes down by the time the contract expires, what effect will that have on your company?

Solutions to Self-Study Problems

20.1 The buyer (owner) of the option has the right to exercise the option but is not required to do so. The seller (or writer) of the option is obligated to take the other side of the transaction if the option owner decides to exercise it.

20.2 First determine the payoffs for the stock, a risk-free loan, and the call option under the two possible outcomes. In one year, the stock price is expected to be either \$8 or \$24. The loan will be worth \$1.06 regardless of whether the project is successful. If the project fails, the stock price will be less than the exercise price of the call option. The option will not be exercised and will be worth \$0. If the project is successful, the stock price will be higher than the exercise price of the call option. The option will be exercised and its value will be the difference between the stock price and the exercise price, \$4.



The stock and loan can be used to create a replicating portfolio, which has the same payoff as the call option:

$(\$8 \times x) + (1.06 \times y) = \$0$

$(\$24 \times x) + (1.06 \times y) = \$4$

Solving the two equations yields $x = 0.25$, $y = -1.887$.

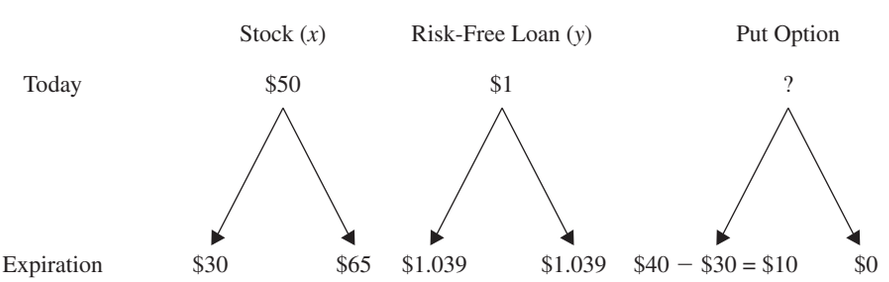
The value of the call option is the same as the current value of this portfolio:

$(\$12 \times 0.25) + (\$1 \times -1.887) = \$1.11$

20.3 Here we solve directly for the value of the put option. First we determine the payoffs for the stock, a risk-free bond, and the put option under the two possible outcomes. To determine payoff of the bond six months from now, we must calculate the six-month, risk-free interest rate given the one-year, risk-free rate in the problem statement:

Six-month, risk-free rate $= (1 + 0.08)^{1/2} - 1 = 0.039$, or 3.9%

The payoffs are therefore:



Now we can use the stock and bond to create a replicating portfolio, which will give the same payoff as the put option:

$(\$30 \times x) + (1.039 \times y) = \$10$

$(\$65 \times x) + (1.039 \times y) = \$0$

Solving the two equations we determine $x = -0.286$, $y = 17.87$.

The value if the put option is the same as the current value of this portfolio:

$(\$50 \times -0.286) + (\$1 \times 17.87) = \$3.58$

Alternatively, you could solve this problem by calculating the value of a call option with an exercise price of $40 per share and then using the put-call parity relation. The value of the call option is $15.09 and value of the associated put option calculated using the put-call parity relation is $3.52. The difference ($3.58 vs. $3.52) is due to rounding and the compounding assumption for the discount rate.

20.4 Several significant real options might be associated with the factory. First, by having a factory in Europe, and the employees and management associated with it, your company might be better positioned to introduce products to the European markets. In addition, you will have options to change operations, to sell the factory, or to simply abandon the project.

20.5 The effect on your company of the decline in the price of oil will be to increase earnings. This is because the oil is an input to your production process, and a drop in prices will reduce your expenses. If the price of oil goes down, you would let the call option expire without exercising it. Of course, the benefit your company receives from the drop in oil prices would be reduced by the amount that you paid to purchase the option.

Discussion Questions

20.1 Options can be combined to create more complicated payoff structures. Consider the combination of one put option and one call option with the same expiration date and the same strike price. Draw the payoff diagram and describe what the purchaser of such a combination thinks will happen before expiration.

20.2 A writer (seller) of a call option may or may not actually own the underlying asset. If he or she owns the asset, and therefore will have the asset available to deliver should the option be exercised, he or she is said to be writing a *covered call*. Otherwise, he or she is writing a *naked call* and will have to buy the underlying asset on the open market should the option be exercised. Draw the payoff diagram of a covered call (including the value of the owned underlying asset) and compare it with the payoff of other options.

20.3 An American option will never be worth less than a European option. Evaluate this statement.

20.4 Explain why, in the binomial pricing theory, the probabilities of an upward move versus a downward move are not important.

20.5 Like all other models, the binomial pricing model is a simplification of reality. In this model, how do we represent high volatility or low volatility of the value of the underlying asset?

20.6 What kinds of real options should be considered in the following situations?

a. Wingnuts R Us is considering two sites for a new factory. One is just large enough for the planned facility, while the other is three times larger.

b. Carousel Cruises is purchasing three new cruise ships to be built sequentially. The first ship will commence construction today and will take one year to build. The second will then be started. Carousel can cancel the order for a given cruise ship at any time before construction begins.

20.7 Future Enterprises is considering building a factory that will include an option to expand operations in three years. If things go well, the expansion will have an expected value of $10 million and will cost $2 million to undertake. Otherwise, the expansion will have an expected value of only $1 million and will not take place. What information would we need in order to analyze this capital budgeting problem using the traditional NPV approach that we would not need using option valuation techniques?

20.8 Corporations frequently include employee stock options as a part of the compensation for their managers and sometimes for all of their employees. These options allow the holder to buy the stock of the company for a prespecified price like any other option, but they are usually very long lived, with maturities of 10 years. The goal of stock option plans is to align the incentives of employees with those of stockholders. What are the implications of these compensation plans for current stockholders?

20.9 You own ABC Corp. bonds. Using option pricing theory, explain what agency concerns you would have if ABC were in danger of bankruptcy.

20.10 A bond covenant is a part of a bond contract that restricts the behavior of the firm, barring it from taking certain actions. Using the terminology of options, explain why a bond contract might include a covenant preventing the firm from making large dividend payments to its stockholders.

20.11 How can the insurance policy on a car be viewed as an option?

Questions and Problems

Basic

20.1 **Option characteristics:** What is an option?

20.2 **Option characteristics:** Explain how the payoff functions differ for the owner (buyer) and the seller of a call option and of a put option.

20.3 **Option payoffs:** What is the payoff for a call option with a strike price of $50 if the stock price at expiration is $40? What if the stock price is $65?

20.4 **Option payoffs:** What is the payoff for a put option with a strike price of $50 if the stock price at expiration is $40? What if the stock price is $65?

20.5 **Option valuation:** What are the five variables that affect the value of an option, and how do changes in each of these variables affect the value of a call option?

20.6 **Option valuation:** Assuming nothing else changes, what happens to the value of an option as time passes and the expiration date gets closer?

20.7 **Option valuation:** What does the seller of a put option hope will happen?

20.8 **Option valuation:** What is the value of a call option or a put option if the stock price is zero? What if the stock price is extremely high (relative to the strike price)?

20.9 **Option valuation:** Like *owners* of stock, *owners* of options can lose no more than the amount they invested. They are far more likely to lose that full amount, but they cannot lose more. Do *sellers* of options have the same limitation on their losses?

20.10 **Option valuation:** What is the value at expiration of a call option with a strike price of $65 if the stock price is $1? $50? $65? $100? $1,000?

20.11 **Option valuation:** Suppose you have an option to buy a share of ABC Corp. stock for $100. The option expires tomorrow, and the current price of ABC Corp. is $95. How much is your option worth?

20.12 **Option valuation:** You hold an American option to sell one share of Zyther Co. stock. The option expires tomorrow. The strike price of the option is $50, and the current stock price is $49. What is the value of exercising the option today? If you wanted to sell the option instead, about how much would you expect to receive?

20.13 **Real options:** What is the difference between a financial option and a real option?

20.14 **Real options:** List and describe four different types of real options that are associated with investment projects.

20.15 **Agency costs:** How are options related to the agency costs of debt and equity?

Intermediate

20.16 **Option valuation:** Suppose that you own a call option and a put option on the same stock and that these options have the same exercise price. Explain how the relative values of these two options will change as the stock price increases or decreases.

20.17 **Other options:** A *callable bond* is a bond that can be bought back by the bond issuer before maturity for some prespecified price (normally a small amount above face value) at the discretion of the bond issuer. How would you go about finding the value of such a bond? Would the bond be worth more or less than an equivalent noncallable bond?

20.18 **Other options:** A *convertible bond* is a bond that can be exchanged for stock at the discretion of the bondholder. How would you go about finding the value of such a bond? Would the bond be worth more or less than an equivalent nonconvertible bond?

20.19 **Option valuation:** The seller of an option can never make any money from a change in the value of the underlying asset; he or she can only hope that the option will not be exercised and that and he or she will not lose any money. Given that this is the case, why do people sell options?

20.20 **Option valuation:** The stock of Socrates Motors is currently trading for $40 and will either rise to $50 or fall to $35 in one month. The risk-free rate for one month is 1.5 percent. What is the value of a one-month call option with a strike price of $40?

20.21 **Option valuation:** Assume that the price of Socrates Motors stock will either rise to $50 or fall to $35 in one month and that the risk-free rate for one month is 1.5 percent. How much is an option with a strike price of $40 worth if the current stock price is $45 instead of $40?

20.22 **Option valuation:** Assume that the stock of Socrates Motors is currently trading for $40 and will either rise to $50 or fall to $35 in one month. The risk-free rate for one month is 1.5 percent. What is the value of a one-month call option with a strike price of $25?

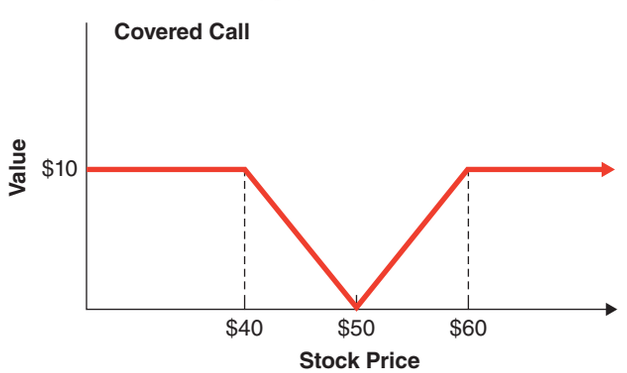
20.23 **Option valuation:** You are considering buying a three-month put option on Wing and a Prayer Construction stock. The company's stock currently trades for $10 per share and its price will either rise to $15 or fall to $7 in three months. The risk-free rate for three months is 2 percent. What is the appropriate price for a put option with a strike price of $9?

20.24 **Option valuation:** You hold a European put option on Tubes, Inc., stock, with a strike price of $100. Things haven't been going too well for Tubes. The current stock price is $2, and you think that it will either rise to $3 or fall to $1.50 at the expiration of your option. The appropriate risk-free rate is 5 percent. What is the value of the option? If this were an American option, would it be worth more?

20.25 **Other options:** A *golden parachute* is a part of a manager's compensation package that makes a large lump-sum payment in the event that the manager is fired or loses his or her job in a merger. Providing such payouts to managers seems ill advised to most people first hearing about it. Explain how a golden parachute can help reduce agency costs between stockholders and managers.

Advanced

20.26 Consider the following payoff diagram.



Find a combination of calls, puts, risk-free bonds, and stock that has this payoff. (You need not use all of these instruments, and there are many possible solutions.)

20.27 Consider the payoff structures of the following two portfolios:

- **a.** Buying a one-month call option on one share of stock at a strike price of $50 and saving the present value of $50 (so that at expiration it will have grown to $50 with interest).
- **b.** Buying a one-month put option on one share of stock at a strike price of $50 and buying one share of stock.

What conclusion can you draw about the relation between call prices and put prices from a comparison of these two portfolios?

20.28 One way to extend the binomial pricing model is by including multiple time periods. Suppose Splittime, Inc., is currently trading for $100 per share. In one month, the price will either increase by $10 (to $110) or decrease by $10 (to $90). The following month will be the same. The price will either increase by $10 or decrease by $10. Notice that in two months, the price could be $120, $100, or $80. The risk-free rate is 1 percent per month. Find the value today of an option to buy one share of Splittime in two months for a strike price of $105. (*Hint:* To do this, first find the possible values of the option at the end of the second month. Then use those values as the payoffs to find the value today.)

20.29 SpinTheWheel Co. has assets currently worth $10 million in the form of one-year, risk-free bonds that will return 10 percent. The company has debt with a face value of $5.5 million due in one year. (No interest payments will be made.) The stockholders decided to sell $8 million of the risk-free bonds and to invest the money in a very risky venture. This venture consists of giving Mr. William Kid the money now and, in one year, flipping a coin. If it comes up heads, Mr. Kid will pay SpinTheWheel $17.6 million. If it is tails, SpinTheWheel gets nothing. This investment has an NPV of zero.

- **a.** What is the value of the debt and equity before the stockholders make this "investment"?
- **b.** Using the binomial pricing model, with the payoff to the equity holders representing the option and the assets of the company representing the underlying asset, estimate the value of the equity after the stockholders make the investment.
- **c.** What is the new value of the debt after the investment?

20.30 The price of a stock that does not pay dividends is currently $35, and the risk-free rate is 4 percent. A European call option on the stock, with a strike price of $35 and that expires in six months, sells for $3.04. A European put option on the same stock with the same strike price sells for $2.35. Is there an arbitrage opportunity here? If so, what is it?

20.31 Two call options have been written on the same underlying stock. Call #1 has a strike price of $42, and call #2 has a strike price of $52. Call #1 is selling for $5.00, and call #2 is selling for $6.00. What arbitrage opportunity do these prices present investors? Show the potential payoffs from this opportunity.

20.32 Husky Motors has two debt issues outstanding, both of which mature in five years. The senior debt issue, which has a face value of $10 million, must be paid in full before any of the principal for the junior debt issue is paid. The junior debt issue also has a face value of $10 million. Draw the payoff diagrams for Husky's equity and both debt issues as the value of the firm changes. Under what circumstances would you expect to see conflicts between the senior and junior debt holders?

20.33 The payoff function for the holder of straight debt looks like that for the seller of a put option. Convertible debt is straight debt plus a call option on a firm's stock. How does the addition of a call option to straight debt affect the concern that lenders have about the asset substitution problem, and why?

Sample Test Problems

20.1 You own a call option on Pepsico stock with a strike price of $60 per share that expires in 60 days. The current market price of Pepsico stock is $63.50 per share. What are the limits on the value of the call option you own?

20.2 Assume that the current market price of Montrose Industrials stock is $28 per share and will either rise to $38 per share or fall to $21 per share in one month. The risk-free rate for one month is 1 percent. What is the value of a one-month call option with a strike price of $24 per share?

20.3 The market value of Whole Foods stock is currently $53.73 per share, and the annual risk-free rate is 3 percent. A three-month call option on the stock with a strike price of $55 sells for $2.15. What is the value of a put option on Whole Foods stock that has the same strike price and expiration date if there are no arbitrage opportunities?

20.4 Why is it hard to account for real options in an NPV analysis?

20.5 Fuel costs are a significant fraction of total costs in the airline industry. How might airline managers use options to manage fuel costs? What is the downside of doing this?

EXHIBIT 21.1 **The World's Largest Multinational Firms Ranked by 2016 Revenue**

Many of the world's 15 largest multinational firms are household names; five of the top 15 are based in the United States, with the balance located in China, Japan, Europe, and South Korea.

Rank	Company	Country	Revenue ($ billions)	Profits ($ billions)
1	Wal-Mart Stores	U.S.A.	$482.1	$14.7
2	State Grid	China	329.6	10.2
3	China National Petroleum	China	299.3	7.1
4	Sinopec	China	294.3	3.6
5	Royal Dutch Shell	Netherlands/U.K.	272.2	1.9
6	Exxon Mobil	U.S.A.	246.2	16.2
7	Volkswagen	Germany	236.6	(1.5)
8	Toyota Motor	Japan	236.6	19.3
9	Apple	U.S.A.	233.7	53.4
10	BP	U.K.	226.0	(6.5)
11	Berkshire Hathaway	U.S.A.	210.8	24.1
12	McKessen	U.S.A.	192.5	2.3
13	Samsung Electronics	South Korea	177.4	16.5
14	Glencore	Switzerland	170.5	(5.0)
15	Industrial and Commercial Bank of China	China	167.2	44.1

Source: http://beta.fortune.com/global500/.

EXHIBIT 21.2 **The Basic Principles of Finance Apply in International Finance**

Most of the basic finance principles discussed in this book remain unchanged in the international context. Where there are differences, they generally result from differences in accounting standards, tax codes, legal and regulatory systems, monetary systems, interest rates, and cultural norms.

Finance Concepts and Procedures	Differences Between Domestic and International Operations
Business risk	Foreign exchange rate and country risk must be taken into account
Form of business organization	Varies with countries' legal and regulatory systems
Ethical norms	Differ with countries' cultural norms
Nominal rate of interest	Affected by the rate of inflation in a given country
Accounting standards	Vary by country
Financial statement analysis	Financial statements must be adjusted for cross-country comparisons
Tax codes	Vary by country
Concept of cash flows	Cash is cash, but monetary units are different
Goal of maximizing shareholders' wealth	Proper goal for U.S.-based firms, but may vary by country
Time value of money	No difference
Bond valuation	Basic valuation concepts are the same, but market conditions differ
Valuation of equity	Basic valuation concepts are the same, but market conditions differ
Net present value analysis	No difference
Operating and financial leverage	No difference
Working capital management	Basic concepts are the same, but market conditions differ
Expected returns and variance	No difference
Cost of debt and equity	Basic concepts are the same, but market conditions and tax systems differ
Weighted average cost of capital	Basic concepts are the same, but market conditions and tax systems differ
Optimal capital structure	Basic concepts are the same, but market conditions and tax systems differ
Payout policy	Basic concepts are the same, but tax systems differ

EXHIBIT 21.3 **Foreign Exchange Rates and the Price of Steel in International Markets**

The exhibit shows the calculations necessary to decide which steel supplier offers the best price: American, British, or Japanese. If the exchange rate between the dollar and the pound is $1.25/£ and the exchange rate between the yen and the dollar is ¥111/$, it makes economic sense to select the Japanese supplier. The situation changes when the exchange rate between pound and dollar falls to $1.15/£.

Supplier	Price in Local Currency	Foreign Exchange Rate	Conversion to Price in U.S. Dollars	Price of Steel in U.S. Dollars
American	$660	–	–	$660.00
British	£536	$1.25/£	£536 × $1.25/£ =	$670.00
Japanese	¥71,500	¥111/$	¥71,500/¥111/$ =	$644.14
British	£536	$1.15/£	£536 × $1.15/£ =	$616.40

APPLICATION 21.1 | Exchange Rates and the Blue Sweater

LEARNING BY DOING

Problem While in a clothing store on Savile Row in London, you find the blue cashmere sweater of your dreams. The sweater is on sale at 50 percent off, priced at £250. "At 50 percent off, the sweater must be a bargain," you say to yourself. "In the states, a sweater like that costs about $300." If the current exchange rate is $1.38/£, is the sweater a bargain?

Approach Of course, the relevant question is, 50 percent off what? The shops on Savile Row in London are very pricey. You will need to use the exchange rate to calculate the price in dollars before comparing the price with that of a comparable sweater in the United States.

Solution The price of the sweater in dollars is £250 × $1.38/£ = $345, which is higher than the $300 price in the United States. It is not such a good deal.

EXAMPLE 21.1 | Exchange Rate Movement: Good or Bad News?

DECISION MAKING

Situation You are the purchasing agent for the U.S.-based firm buying steel in the example just discussed in the text. Your assistant, Omar, who is a British subject, runs into the office and breathlessly says, "The pound is stronger against the dollar! The new exchange rate is $1.32/£!" Is Omar's report good news or bad news?

Decision The fact that the pound has risen in value against the dollar is good news for Omar, because the British pounds he owns will now buy more U.S. goods. But for your firm, the news is bad. It now takes more U.S. dollars to purchase one British pound. At the new exchange rate, the British steel costs $707.52 per ton (£536 × $1.32/£ = $707.52).

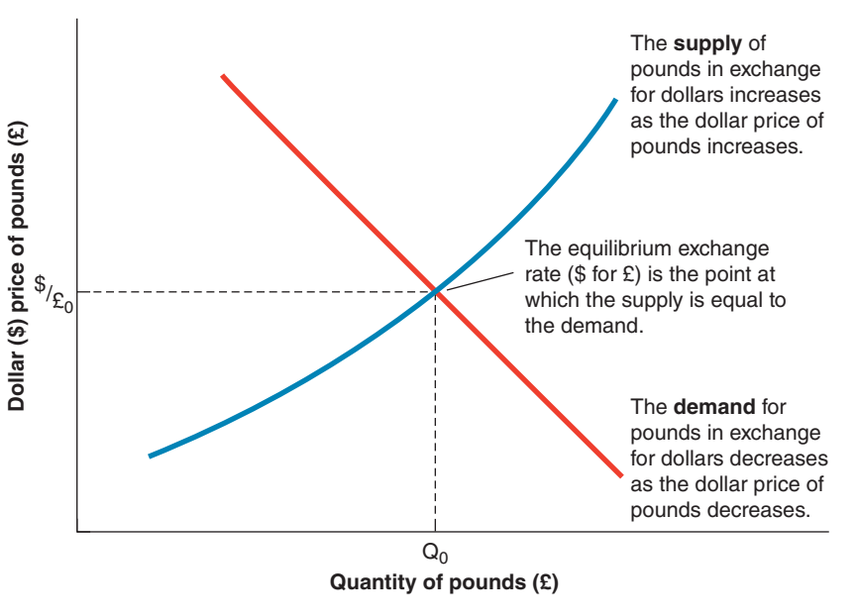


EXHIBIT 21.4 **The Equilibrium Exchange Rate**

The supply of and demand for pounds move in opposite directions. The equilibrium exchange rate occurs at the intersection of the supply and demand curves. At this point, the quantity of the currency demanded equals the quantity supplied.

EXHIBIT 21.5 Spot Foreign Exchange Rates and Cross Rates

Panel A of the exhibit shows the cross rates for seven currencies commonly dealt with in the United States. Panel B lists spot and forward rates for selected currencies. Columns 2 and 3 in Panel B show how many U.S. dollars it takes to buy one unit of the foreign currency, and columns 4 and 5 show how much foreign currency it takes to purchase one U.S. dollar.

Panel A: Key Currency Cross Rates — March 14th, 2017. 5 p.m. Eastern Standard Time

	Dollar	Euro	Pound	SFranc	Peso	Yen	CdnDlr
Canada	1.3480	1.4294	1.6383	1.3343	0.0685	0.0117	...
Japan	114.7430	121.6792	139.4586	113.5844	5.8348	...	85.1241
Mexico	19.6652	20.8540	23.9011	19.4666	...	0.1714	14.5890
Switzerland	1.0102	1.0713	0.1228	...	0.0514	0.0088	0.7494
U.K.	0.8228	0.8725	...	0.8145	0.0418	0.0072	0.6104
Euro	0.9430	...	1.1461	0.9335	0.0480	0.0082	0.6996
U.S.	...	1.0605	1.2154	0.9899	0.0509	0.0087	0.7419

Source: Tullett Prebon

continued

EXHIBIT 21.5 **Spot Foreign Exchange Rates and Cross Rates (*continued*)**

Panel B: Foreign Exchange Data for Tuesday March 14, 2017

	USD Equivalent		Currency per USD	
Country/currency	**Tuesday**	**Monday**	**Tuesday**	**Monday**
Americas:				
Argentina peso	0.0644	0.0644	15.5385	15.5318
Brazil real	0.3155	0.3172	3.1695	3.1525
Canada dollar	0.7419	0.7437	1.3480	1.3447
Chile peso	0.001494	0.001500	669.4	666.7
Colombia peso	0.0003337	0.0003351	2,996.98	2,984.05
Ecuador U.S. dollar	1	1	1	1
Mexico peso	0.0509	0.0510	19.6652	19.6173
Peru new sol	0.3049	0.3046	3.2796	3.2835
Uruguay peso	0.03525	0.03527	28.37	28.35
Venezuela bolivar	0.10004952	0.10009960	9.9951	9.9901
Asia-Pacific:				
Australian dollar	0.7559	0.7571	1.3229	1.3208
1-mos forward	0.7650	0.7563	1.3072	1.3222
3-mos forward	0.7551	0.7558	1.3243	1.3231
6-mos forward	0.7540	0.7520	1.3263	1.3298
China yuan	0.1446	0.1446	6.9144	6.9145
Hong Kong dollar	0.1287	0.1288	7.7673	7.7647
India rupee	0.01520	0.01511	65.7705	66.1804
Indonesia rupiah	0.0000748	0.0000749	13371	13358
Japan yen	0.00872	0.00870	114.74	114.88
1-mos forward	0.008371	0.008713	119.4600	114.7710
3-mos forward	0.008754	0.008742	114.2335	114.3903
6-mos forward	0.008796	0.008780	113.6880	113.8952
Kazakhstan tenge	0.00314	0.00314	318.2	318.43
Macau pataca	0.1249938	0.1258986	8.000	7.943
Malaysia ringgit	0.2247	0.2249	4.4495	4.4465
New Zealand dollar	0.6919	0.6923	1.4453	1.4445
Pakistan rupee	0.00954	0.00954	104.8	104.8
Philippines peso	0.0199	0.0199	50.316	50.282
Singapore dollar	0.7064	0.7071	1.4156	1.4142
South Korea won	0.0008696	0.0008711	1149.97	1148
Sri Lanka rupee	0.0065854	0.0066636	151.85	150.07
Taiwan dollar	0.0323	0.03233	30.96	30.93
Thailand baht	0.02832	0.02834	35.31	35.29
Vietnam dong	0.00004385	0.00004406	22805	22695

Country/currency	USD Equivalent		Currency per USD	
	Tuesday	Monday	Tuesday	Monday
Europe:				
Bulgaria lev	0.54283	0.54469	1.842	1.836
Croatia kuna	0.1428	0.1434	7.0019	6.9732
Czech Rep. koruna	0.03924	0.03943	25.481	25.364
Denmark krone	0.1426	0.1433	7.0102	6.9783
Euro area euro	1.0605	1.0653	0.943	0.9387
Hungary forint	0.00340727	0.00341227	293.49	293.06
Iceland krona	0.009029	0.009020	110.76	110.86
Norway krone	0.1161	0.1167	8.6122	8.566
Poland zloty	0.2457	0.2462	4.0699	4.0621
Romania leu	0.2335	0.234	4.2832	4.2733
Russia ruble	0.0169	0.01699	59.183	58.843
Sweden krona	0.1115	0.1118	8.9712	8.9424
Switzerland franc	0.9899	0.9928	1.0102	1.0073
3-mos forward	0.9960	0.9988	1.0040	1.0012
Turkey lira	0.2672	0.2673	3.7425	3.7418
Ukraine hryvnia	0.0371	0.0375	26.9435	26.6470
UK pound	1.2154	1.2218	0.8228	0.8185
1-mos forward	1.2172	1.2232	0.8216	0.8175
3-mos forward	1.2190	1.2249	0.8203	0.8164
6-mos forward	1.2223	1.2279	0.8181	0.8144
Middle East/Africa:				
Bahrain dinar	2.6522	2.6539	0.3771	0.3768
Egypt pound	0.0554	0.0556	18.0485	17.9805
Israel shekel	0.2727	0.2729	3.667	3.6641
Kuwait dinar	3.272	3.2737	0.3056	0.3055
Oman sul rial	2.5975	2.59703	0.38	0.39
Qatar rial	0.2747	0.2746	3.6408	3.6410
Saudi Arabia riyal	0.2667	0.2667	3.7502	3.7496
South Africa rand	0.0760	0.0761	13.1527	13.1380

Sources: SIX Financial Information, Tullett Prebon, and the Wall Street Journal Market Data Group as reprinted in the *Wall Street Journal Online*, March 14, 2017.

$$\text{Bid-ask spread} = \frac{\text{Ask rate} - \text{Bid rate}}{\text{Ask rate}} \qquad (21.1)$$

LEARNING BY DOING

APPLICATION 21.2 | Cross Exchange Rates

Problem An American executive is going on a business trip to Japan and England. Before she departs, the executive purchases $10,000 worth of Japanese yen at the prevailing rate of ¥114.74/$. After finishing her business in Japan, she departs for London, where she converts her remaining yen to British pounds. She sells ¥512,375 at a rate of ¥139.4586/£. She finally returns to the United States with £567.35, which she would like to convert to U.S. dollars. Based only on the rates given, how many dollars will she receive if she sells the pounds?

Approach To solve this problem, you need to know the exchange rate, or cross rate, between the U.S. dollar and the British pound. Given the other two exchange rates, you can calculate this rate by dividing the ¥/£ rate by the ¥/$ rate.

Solution

$$\text{Cross rate} = \frac{¥139.4586/£}{¥114.74/\$} = \$1.2154/£$$

$$\text{Amount of dollars received} = £567.35 \times \$1.2154/£ = \$689.55$$

$$\text{Forward premium (discount)} = \frac{\text{Forward rate} - \text{Spot rate}}{\text{Spot rate}} \times \frac{360}{n} \times 100 \qquad (21.2)$$

LEARNING BY DOING

APPLICATION 21.3 | Forward Premium (Discount)

Problem Ian Chappell is planning a trip from Sydney, Australia, to visit his brother, who works in India. He plans to make the trip in six months. In preparing his budget for the trip, he finds that the spot rate for Indian rupees is Rs54.4811 per Australian dollar (A$). He also finds the six-month forward rate to be Rs50.9001/A$. What is the forward premium or discount on the Indian rupees against the Australian dollar?

Approach Recognize that the Australian dollar will buy fewer Indian rupees in six months than now. This means that the Indian rupee is at a forward premium against the Australian dollar or that the Australian dollar is at a discount against the rupee. To find out how much, we use Equation 21.2.

Solution Using Equation 21.2, we calculate the value as:

$$\text{Forward discount} = \frac{Rs50.9001/A\$ - Rs54.4811/A\$}{Rs54.4811/A\$} \times \frac{360}{180} \times 100 = -13.15\%$$

Thus, the Australian dollar is at a forward discount of 13.15 percent against the Indian rupee.

Figure 21.1

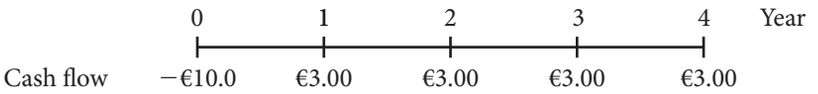


EXHIBIT 21.6 **Composite Country Risk Ratings for Selected Countries in 2016**

The composite risk for a country is determined by the country's political, financial, and economic risk. A higher number means lower risk. Are you surprised by the rank of the United States?

Rank	Country	Composite Risk	Rank	Country	Composite Risk
1	Switzerland	88.5	22	Australia	78.3
2	Norway	88.0	24	Israel	77.8
3	Luxembourg	87.0	26	United Kingdom	77.5
4	Singapore	86.3	33	Italy	75.3
5	Sweden	86.0	38	Spain	74.5
6	Germany	85.0	49	France	72.3
7	New Zealand	83.3	53	China, Peoples' Rep.	71.5
8	Taiwan	83.0	59	Cuba	70.3
9	Canada	82.8	66	India	69.8
10	Korea, Republic	82.5	70	Mexico	67.8
11	Netherlands	82.5	73	Russia	67.3
12	Ireland	82.0	78	Greece	66.8
13	Denmark	81.8	81	Indonesia	65.8
13	Japan	81.8	85	Brazil	64.8
15	Finland	81.3	94	Tanzania	63.8
16	Hong Kong	80.8	99	Turkey	63.3
17	Iceland	80.5	105	Kenya	62.5
18	Austria	79.5	119	Ukraine	59.8
19	Czech Republic	79.5	138	Syria	46.8
20	United States	79.3	140	Venezuela	41.0

Rankings are provided for the 140 surveyed countries. Composite scores range from 0 to 100 with countries broken into categories ranging from very low risk (80 to 100) to very high risk (0 to 49.9).
Source: PRS Group (www.prsgroup.com), July 2016.

Figure 21.2

Year (1)	Cash Flow (€ millions) (2)	EFX Rate (3)	Calculation (4)	Cash Flow ($ millions) (5)
0	−€10.00	$1.20/€	−€10.00 × $1.20/€	−$12.00
1	3.00	1.25	3.00 × 1.25	3.75
2	3.00	1.30	3.00 × 1.30	3.90
3	3.00	1.32	3.00 × 1.32	3.96
4	3.00	1.35	3.00 × 1.35	4.05

Figure 21.3

$$\begin{aligned} \text{NPV} &= -\$12.00 + \frac{\$3.75}{1.10} + \frac{\$3.90}{(1.10)^2} + \frac{\$3.96}{(1.10)^3} + \frac{\$4.05}{(1.10)^4} \\ &= -\$12.00 + \$3.41 + \$3.22 + \$2.98 + \$2.77 \\ &= \$0.38 \end{aligned}$$

LEARNING BY DOING

APPLICATION 21.4 | International Capital Budgeting

Problem A U.S. electronics firm is establishing a manufacturing plant in Taiwan to produce components that will be sold to customers in Taiwan. The cost of the investment is $10 million. The project is expected to last five years and then shut down. The company usually uses a discount rate of 7.5 percent for domestic projects like this, but for this project, the financial manager adds a 2.5 percent country risk premium. The following time line shows the expected cash flows in millions of Taiwanese dollars (TWD) and the forecasted year-end exchange rates between the U.S. dollar and the Taiwanese dollar.

	1	2	3	4	5	Year
Cash flows (millions of TWD)	64.3	71.2	93.6	121.8	109.6	
Expected exchange rate (TWD/$)	32.031	33.632	36.155	32.221	33.670	

What is the NPV of this project?

Approach Since we know the expected cash flows in the foreign currency and the expected exchange rates, we can calculate the expected cash flows to the parent firm in U.S. dollars by dividing the TWD cash flows by the appropriate exchange rate. We also must adjust the project discount rate for the 2.5 percent country risk premium.

Solution The following table shows the conversion of the cash flows from the U.S. firm expects to receive from Taiwanese dollars to U.S. dollars.

Year	Cash Flows (TWD millions)		Exchange Rate		Cash Flows ($ millions)
0					−$10.00
1	64.3 TWD	÷	32.031 TWD/$	=	2.01
2	71.2	÷	33.632	=	2.12
3	93.6	÷	36.155	=	2.59
4	121.8	÷	32.221	=	3.78
5	109.6	÷	33.670	=	3.26

The appropriate discount rate is 2.5 percent over the discount rate that the firm normally uses for domestic capital budgeting projects. Thus, the discount rate to be used is 10 percent (2.5 + 7.5 = 10). By discounting the cash flows at the risk-adjusted discount rate of 10 percent, we can compute the NPV for this project.

$$\begin{aligned}\text{NPV} &= -\$10.00 + \frac{\$2.01}{1.10} + \frac{\$2.12}{(1.10)^2} + \frac{\$2.59}{(1.10)^3} + \frac{\$3.78}{(1.10)^4} + \frac{\$3.26}{(1.10)^5} \\ &= -\$10.00 + \$1.83 + \$1.75 + \$1.95 + \$2.58 + \$2.02 \\ &= \$0.13 \text{ million}\end{aligned}$$

Since the NPV is positive, the project should be accepted.

APPLICATION 21.5 | Eurodollar versus Domestic Bond Issue

LEARNING BY DOING

Problem Suppose Hewlett-Packard (HP) needs $350 million to build a new facility. The firm plans to finance the facility by selling bonds domestically or in the Eurodollar bond market. In either case, the bond issue will have a maturity of three years, a par value of $1,000, and coupon interest payments totaling $50 a year. After transaction costs and underwriters' fees, the domestic bond issue will net $951.90 per bond, and the Eurodollar bonds will net $948.00 per bond. Which bonds—domestic or Eurodollar—should HP issue?

Approach Fortunately, we know from Chapter 8 that the best deal is the alternative that offers the lowest interest cost. You may want to review the bond yield calculation formulas in Section 8.3 of Chapter 8. Drawing on those formulas, we calculate the yield to maturity for each alternative. Because bond issues pay coupon interest semiannually in the United States and annually in Europe, we must also compute the effective annual yield (EAY) for the domestic bonds in order to compare it with the yield on the Eurodollar bonds.

Solution For the Eurodollar bond, the annual coupon payment is $50 per year, and the yield calculation is:

$$\$948.00 = \frac{\$50}{1+i} + \frac{\$50}{(1+i)^2} + \frac{\$1{,}050}{(1+i)^3}$$

Using our financial calculator, we find that the Eurodollar bond issue's annual yield is 6.9808 percent.

For the domestic bond issue, the semiannual coupon payments are $25 ($50/2 = $25), and the semiannual bond yield calculation is:

$$\$951.90 = \frac{\$25}{1+i} + \frac{\$25}{(1+i)^2} + \cdots + \frac{\$1{,}025}{(1+i)^6}$$

The bond issue's semiannual yield is 3.3997 percent. We now apply the EAY formula from Chapter 8 to find the effective annual yield for the domestic bonds:

$$\begin{aligned}\text{EAY} &= (1 + \text{Quoted interest rate}/m)^m - 1 \\ &= (1 + 0.033997)^2 - 1 \\ &= 1.0691 - 1 \\ &= 6.91\%\end{aligned}$$

The domestic bond issue, with a 6.91 percent effective annual yield, will provide the lower interest cost, all other things being equal. Of course, the fact that the domestic bond nets a higher price per $1,000 owed tells us that this bond has a lower interest cost. We just did not know precisely how much lower without performing the calculations.

EXHIBIT 21.7 **The World's Largest Banks in 2016**

The exhibit lists the 15 largest banks in the world ranked on the basis of global sales, profits, assets, and market value. Industrial and Commercial Bank of China is the world's largest bank with total assets of $3,420.3 billion. By country, the majority of the top 15 banks are located in China and the United States.

Rank	Bank Name	Country	Total Assets ($ billions)	Revenue ($ billions)	Profits ($ billions)
1	Industrial and Commercial Bank of China	China	3,420.3	$171.1	$44.2
2	China Construction Bank	China	2,826.0	146.8	36.4
3	Agricultural Bank of China	China	2,739.8	131.9	28.8
4	JP Morgan Chase	U.S.A	2,423.8	99.9	23.5
5	Bank of China	China	2,589.6	122.0	27.2
6	Wells Fargo	U.S.A	1,849.2	91.4	22.7
7	Bank of America	U.S.A	2,185.5	91.5	15.8
8	Citigroup	U.S.A	1,801.0	85.9	15.8
9	HSBC Holdings	U.K.	2,409.7	70.3	13.5
10	BNP Paribas	France	2,166.3	74.9	7.4
11	Mitsubishi UFJ Financial	Japan	2,458.8	44.2	7.9
12	Bank of Communications	China	1,101.9	57.0	10.6
13	Banco Santander	Spain	1,455.9	49.8	6.6
14	China Merchants Bank	China	843.1	48.2	9.2
15	Royal Bank of Canada	Canada	853.0	33.1	7.7

Source: "The World's Biggest Companies," https://www.forbes.com/global2000/

$$k = \text{BR} + \text{DRP} + \text{FXR} + \text{CR} + \text{GPMAR} \qquad (21.3)$$

APPLICATION 21.6 | Interest on a Eurocredit Loan

LEARNING BY DOING

Problem Siemens International can borrow $5 million from HSBC at LIBOR plus a lending margin of 0.5 percent on a three-month rollover Eurocredit loan. Suppose that the prevailing annualized LIBOR rate is 1.1 percent and that over the next three-month period, the LIBOR rate is expected to increase to 1.25 percent. How much interest will Siemens have to pay HSBC for the Eurocredit loan for the first six months?

Approach The total expected interest cost of the Siemens loan is the sum of the interest paid for the first three months plus the expected interest paid over the next three months.

Solution Siemens's annualized borrowing cost is 1.6 percent (1.1 percent + 0.5 percent = 1.6 percent) for the first three-month period and is expected to be 1.75 percent (1.25 percent + 0.5 percent = 1.75 percent) for the next three-month period; thus, the total interest cost for the six-month period is as follows:

$$\begin{aligned}\text{Total interest cost} &= (\$5{,}000{,}000 \times 0.016 \times 0.25 \text{ year}) + (\$5{,}000{,}000 \times 0.0175 \times 0.25 \text{ year}) \\ &= \$20{,}000 + \$21{,}875 \\ &= \$41{,}875\end{aligned}$$

Summary of Key Equations

Equation	Description	Formula
21.1	Bid-ask spread	$\text{Bid-ask spread} = \dfrac{\text{Ask rate} - \text{Bid rate}}{\text{Ask rate}}$
21.2	Forward premium or discount	$\text{Forward premium (discount)} = \dfrac{\text{Forward rate} - \text{Spot rate}}{\text{Spot rate}} \times \dfrac{360}{n} \times 100$
21.3	Eurocredit bank loan pricing	$k = \text{BR} + \text{DRP} + \text{FXR} + \text{CR} + \text{GPMAR}$

Self-Study Problems

21.1 If a Volkswagen Passat costs $26,350 in Baltimore and €21,675 in Frankfurt, what is the implied exchange rate between the U.S. dollar and the euro?

21.2 Calculate the indicated exchange rates given the following information.

Given	Compute
a. ¥101.3500/$	$/¥
b. $1.8694/£	£/$
c. $0.9981/C$	C$/$

21.3 Management of Digital, Inc., an electronic games manufacturer, is planning to purchase flash memory from one of two sources. Kyoto, Inc., quotes a price of ¥6,800 per gigabyte. The current exchange rate is ¥102.30/$. Another Japanese manufacturer offers to supply the same flash memory at a price of €58.46 per gigabyte. The spot rate available is ¥141.60/€. Which is the cheaper source of flash memory for Digital?

21.4 Columbia Corp. has just made a sale to a British customer. The sale was for a total value of £135,000 and is to be paid 60 days from now. Columbia management is concerned that the British pound will depreciate against the U.S. dollar and plans to hedge this risk. The company's bank informs management that the spot rate is $1.2461/£ and the 60-day forward rate is $1.2283/£. If Columbia sells its pounds receivable at the forward rate, what is the dollar value of its receivables? If it does not enter into a forward contract and the spot rate 60 days later is $1.2107/£, how much would the company lose by not hedging?

21.5 American Bancorp management is planning to make a $3.5 million loan to a French firm. Currently, LIBOR is at 1.5 percent. American management considers a default risk premium of 1.15 percent, a foreign exchange rate risk premium of 0.35 percent, and a country risk premium of 0.13 percent to be appropriate for this loan. What is the loan rate charged by American Bancorp?

Solutions to Self-Study Problems

21.1 Cost of the car in Baltimore = \$26,350

Cost of the car in Frankfurt = €21,675

$$\text{Dollar to euro exchange rate} = \frac{\$26{,}350}{€21{,}675} = \$1.2157/€$$

21.2 **a.** 1/¥101.3500/\$ \$0.00987/¥

b. 1/\$1.8694/£ £0.5349/\$

c. 1/\$0.9981/C\$ = C\$1.00190/\$

21.3 Cost from Vendor 1:

Flash memory price quote = ¥6,800 per gigabyte

Spot rate for U.S. dollar = ¥102.30/\$

$$\text{Cost to Digital in dollars} = \frac{¥6{,}800}{¥102.30/\$} = \$66.47 \text{ per gigabyte}$$

Cost from Vendor 2:

Flash memory price quote = €58.46 per gigabyte

Spot rate for U.S. dollar = ¥141.60/€

To compute the dollar cost, we need to compute the cross rate between the euro and the dollar.

$$\frac{¥141.60/€}{¥102.30/\$} = \$1.3842/€$$

Cost to Digital in dollars = €58.46 × \$1.3842/€

= \$80.92 per gigabyte

The first vendor has the cheaper quote for Digital.

21.4 Amount received by Columbia by selling at the forward rate:

= £135,000 × \$1.2283/£ = \$165,820.50

Amount received by Columbia by selling at the spot rate 60 days later:

= £135,000 × \$1.2107/£ = \$163,444.50

Loss incurred by not hedging = \$165,820.50 − \$163,444.50 = \$2,376.00

21.5 The loan rate charged by American Bancorp is calculated as follows:

$$\begin{aligned} k &= \text{BR} + \text{DRP} + \text{FXR} + \text{CR} \\ &= 1.5\% + 1.15\% + 0.35\% + 0.13\% \\ &= 3.13\% \end{aligned}$$

Discussion Questions

21.1 Royal Dutch Shell, an oil company, has headquarters in both the Netherlands and the United Kingdom. What type of firm is it?

21.2 International economic integration and technological changes in the last couple of decades have dramatically increased globalization across many industries. Explain how a biotech firm or a medical firm (for example, a hospital) can take advantage of these changes.

21.3 In the United States, managers are asked to focus on maximizing stockholder value. Is this consistent with the goals of managers in Germany and Japan?

21.4 A Canadian cooperative of wheat farmers sold wheat to a grain company in Russia. Under what circumstances will the Canadian farmers be exposed to foreign exchange rate risk? When will the Russian importer be facing foreign exchange rate risk?

21.5 Stardust, Inc., is an exporter of plumbing fixtures. About 30 percent of its sales are made in Canada. The sales department just found out that the Canadian dollar is at a premium against the U.S. dollar based on the 90-day forward rate, while the 180-day forward rate indicates that the Canadian dollar is at a forward discount. What is the likely impact of these rates on the company's sales to Canada?

21.6 Mello Wines, a California winery, grows its grapes locally, uses local labor, and sells its wines only in the United States. Can this firm be exposed to foreign exchange rate risk?

21.7 A U.S. firm owns a subsidiary in Belgium. What kind of foreign exchange rate risk does the U.S. firm face?

21.8 Ray Corp. is a U.S. electronics manufacturer with a production plant in Turkey. This morning, the Turkish government introduced a new law prohibiting the repatriation of any funds from the country for two years. What type of risk does Ray Corp. face?

27.9 Suppose GE issues bearer bonds in France denominated in British pounds. What type of bonds are these?

21.10 Give examples of U.S. banks facing different risks in international lending.

Questions and Problems

Basic

21.1 **Spot rate:** Ryan wants to buy a pair of leather shoes at Harrods in London that costs £113.60. If the exchange rate is $1.6177/£, what is Ryan's cost in U.S. dollars?

21.2 **Spot rate:** Crescent Corporation's recent sale to a firm in Mexico produced revenues of 13,144,800 Mexican pesos. If the firm sold the pesos to its bank and was credited with $1,077,873.60, what was the spot rate at which the pesos were converted?

21.3 **Spot rate:** Given the following direct quotes, calculate the equivalent indirect quotes.

a. $0.0844/Mexican peso

b. £0.8513/€

c. Rs54.64/C$

21.4 **Spot rate:** Convert the following indirect quotes to the appropriate American quotes.

a. £0.6917/$

b. ¥104.28/$

c. SF 1.0769/$

21.5 **Spot rate:** Suppose a BMW 528i is priced at $68,750 in New York and €50,267 in Berlin. In which place is the car more expensive if the spot rate is $1.1077/€?

21.6 **Forward rate:** Explain the relation between each pair of currencies.

Spot Rate	Forward Rate
a. $1.655/£	$1.6001/£
b. ¥104.45/$	¥102.33/$
c. C$1.1121/$	C$1.0940/$

21.7 **Forward rate:** If the spot rate was $1.0413/C$ and the 90-day forward rate was $1.0507/C$, how much more (in U.S. dollars) would you receive by selling C$1,000,000 at the forward rate than at the spot rate?

21.8 **Forward rate:** Crane, Inc., sold equipment to an Irish firm and will receive €1,319,405 in 30 days. If the company entered a forward contract to sell at the 30-day forward rate of $1.0812/€, what is the dollar revenue received?

21.9 **Forward rate:** Brilliant Equipment purchased machinery from a Japanese firm and must make a payment of ¥313.25 million in 45 days. The bank quotes a forward rate of ¥103.01/$ to buy the required yen. What is the cost to Brilliant in U.S. dollars?

21.10 **Forward rate:** Triumph Autos has contracted with an Indian software firm for design software. The payment of 22,779,750 rupees (Rs) is due in 30 days. What is the cost in dollars if the 30-day for-ward rate is Rs64.39/$.

21.11 **Forward rate:** Use the data in Exhibit 21.5 to answer these questions:

a. What is the three-month forward rate (in U.S. dollars) for Swiss francs? Is the Swiss franc selling for a premium or a discount?

b. What is the three-month forward rate (in U.S. dollars) for the Japanese yen? Is the Japanese yen selling for a premium or a discount?

c. Given the information above, what do you think will happen to the value of the Swiss franc and the Japanese yen relative to the U.S. dollar?

21.12 Bid-ask spread: Nova Scotia Bank offers quotes on the Canadian dollar as shown below. What is the bid-ask spread based on these quotes?

Bid	Ask
C$1.3081/$	C$1.3087/$

21.13 Bid-ask spread: A local community bank has requested foreign exchange quotes for the Swiss franc from Citibank. Citibank quotes a bid rate of $1.0934/SF and an ask rate of $1.0997/SF. What is the bid-ask spread?

21.14 Bid-ask spread: A foreign exchange dealer is willing to buy the Danish krone (DKr) at $0.1556/DKr and will sell it at a rate of $0.1563/DKr. What is the bid-ask spread on the Danish krone?

21.15 Cross rate: Given the following quotes, calculate the €/£ cross rate.

Bank of America	$ 1.663/£
JP Morgan Chase	$1.3914/€

21.16 Cross rate: Barclays Bank of London has offered the following exchange rate quotes: ¥134.64/£ and Korean won 13.8374/¥. What is the cross rate between the Korean won and the British pound?

21.17 Cross rate: Bremer Corporation observes that the Swiss franc (SF) is being quoted at €0.7660/SF, while the Swedish krona (SK) is quoted at €0.1114/SK. What is the SK/SF cross rate?

21.18 Country risk: Ford Motor Company maintains production facilities in many different countries including Brazil, Taiwan, and the United States. Given the data in Exhibit 21.6, which production plant is likely to face the greatest country risk? How does country risk affect a firm's capital budgeting decisions?

21.19 Foreign exchange rate risk: How is transaction exposure different from operating exposure?

21.20 International debt: What are Yankee bonds?

Intermediate

21.21 Forward premium: The spot rate on the London market is £0.7531/$, while the 90-day forward rate is £0.7602/$. What is the annualized forward premium or discount on the British pound?

21.22 Forward premium: Bank of America quoted the 180-day forward rate on the Swiss franc at $1.0407/SF. The spot rate was quoted at $1.0268/SF. What is the forward premium or discount on the Swiss franc?

21.23 Forward premium: The foreign exchange department at Tokyo's Daiwa Bank quoted the spot rate on the euro at €0.007269/¥. The 90-day forward rate is quoted at a premium of 5.42 percent on the euro. What is the 90-day forward rate?

21.24 Forward premium: The spot rate of the Australian dollar (A$) is A$1.1667/$. The Australian dollar is quoted at a 30-day forward premium of 4.90 percent against the U.S. dollar. What is the 30-day forward quote?

21.25 Bid-ask spread: The foreign exchange department of Bank of America has a bid quote on Canadian dollars (C$) of C$1.0800/$. If the bank typically tries to make a bid-ask spread of 0.5 percent on these foreign exchange transactions, what will the ask rate have to be?

21.26 Bid-ask spread: Banco Santiago wants to make a bid-ask spread of 0.65 percent on its foreign exchange transactions. If the ask rate on the Mexican peso (MP) is MP18.3092/$, what does the bid rate have to be?

21.27 Cross rate: Alcor Pharma just received revenues of $3,165,300 in Australian dollars (A$). Management has the following exchange rates: A$1.8010/£ and $1.5906/£. What is the U.S. dollar value of the company's revenues?

21.28 Cross rate: Flint Corp. recently purchased auto parts worth 17.5 million Mexican pesos (MP) on credit. Management needs to find out the U.S. dollar cost of the purchase. It has access to two quotes for Canadian dollars (C$): C$1.0174/$ and C$0.0820/MP. What did it cost Flint to purchase the auto parts?

21.29 Hedging: Tricolor Industries has purchased equipment from a Brazilian firm for a total cost of 272,500 Brazilian reals. The firm has to pay in 30 days. Citibank has given the firm a 30-day forward quote of $0.3102/real. Assume that on the day the payment is due, the spot rate is $0.3417/real. How much would Tricolor save by hedging with a forward contract?

21.30 Eurocredit loan: A Swiss sporting goods company borrows in yen in the Eurocredit market at a rate of 4.35 percent from Bank of America using a three-month rollover loan. Bank of America assigns a default risk premium of 2 percent on the loan, and the country risk is an additional 0.75 percent. The bank can borrow funds in the Euromarket at the three-month LIBOR rate of 0.40 percent. What is Bank of America's gross profit margin on this loan?

Advanced

21.31 Covington Industries just sold equipment to a Mexican firm. Payment of 11,315,000 Mexican pesos (MP) will be due to Covington in 30 days. Covington has the option of selling the pesos today at a 30-day forward rate of $0.05139/MP. If it waits 30 days to sell the pesos, the expected spot rate is $0.04881/MP. In dollars, how much better off is Covington by selling the pesos in the forward market?

21.32 Barrington Fertilizers, Inc., exports its specialized lawn care products to Canada. It made a sale worth C$1,150,000, with the payment due in 90 days. Barrington's banker gave it a forward quote of $0.9021/C$. By using the forward rate, the firm gained an additional $8,433.25 over what it would have gotten if it had sold the Canadian dollars in the spot market 90 days later. What was the spot rate at the time the payment was received?

21.33 Moon Rhee Auto Supply, a Korean supplier of parts to Kia Motors, is evaluating an opportunity to set up a plant in Alabama, where Kia Motors has an auto assembly plant for its SUVs. The cost of this plant will be $13.5 million. The current spot rate is 1,120.318 Korean won per U.S. dollar. The firm is expected to use this plant for the next five years and is expecting to generate the following cash flows:

	Year				
	1	2	3	4	5
Cash flows ($ millions)	$2.3	$4.2	$3.6	$5.8	$7.6
Expected exchange rate (Korean won/$)	1,105.231	1,115.632	1,146.155	1,120.221	1,110.670

The firm uses a discount rate of 9 percent for projects like this in the United States.

What is the NPV of this project? Should Moon Rhee Auto Supply take on this project?

21.34 The Boeing Company has two different debt issues, both maturing four years from now. The domestic bond issue pays semiannual coupons and has a coupon rate of 4.80 percent. The current price on the bond is $962.75. The Eurobond issue is priced at $964.33 and pays an annual coupon of 4.95 percent. What is the yield to maturity for each bond?

21.35 Caterpillar, Inc., management is trying to decide between selling a new bond issue in the U.S. or the Eurodollar bond market. In either market the bonds will be denominated in dollars and will have a three-year maturity. The domestic bonds will have a coupon rate of 4.1 percent and sell at a market price of $1,034.25. The Eurobonds will have a coupon rate of 4 percent, paid annually, and will sell at $1,029.76. Which bond issue will have the lower cost to the firm?

21.36 IBM's German unit is looking to borrow €7.5 million from Deutsche Bank. Deutsche Bank quotes a rate of three-month LIBOR plus 0.25 percent for the 90-day loan. Currently, the three-month LIBOR is 3.875 percent. What is IBM's interest cost on the loan in euros? If the exchange rate on the payoff date is €0.8164/$, what is the dollar cost of the loan?

21.37 Toyota is interested in borrowing $5 million for 90 days. Bank of America has quoted a rate that is 1.125 percent under the prime rate of 6.25 percent. Daiwa Bank is offering Toyota a rate that is 0.75 percent over the three-month LIBOR of 4.2 percent. Which is the better deal for Toyota, and what is the lower interest cost in dollars?

Sample Test Problems

21.1 What are six factors that cause international transactions to differ from domestic transactions?

21.2 If a Dell Studio laptop sells for $999 in Austin, Texas, and £689 in London, what is the implied exchange rate between the U.S. dollar and the euro?

21.3 A bank in India has offered a spot rate quote on Indian rupees (Rs) of Rs62.2905/$. The Indian rupee is quoted at a 30-day forward premium of 5.22 percent against the dollar. What is the 30-day forward quote?

21.4 Technocorp has purchased industrial parts from a German company for a total cost of €1,225,000. The firm has 30 days to pay. A bank has given Technocorp a 30-day forward quote of $1.1278/€. Assume that on the day the payment is due, the spot rate is $1.1468/€. How much would Technocorp have saved by hedging with a forward contract?

21.5 Tass Co., Ltd, a Japanese electrical parts producer, is considering building a plant in the United States. The cost of this plant will be $20 million, and the current spot exchange rate between the yen and the U.S. dollar is ¥101.8/$. Tass management expects to use this plant for the next five years and expects it to generate the following cash flows during this period:

	Year				
	1	2	3	4	5
Cash flows ($ millions)	$2.0	$3.6	$5.0	$6.8	$8.0
Expected exchange rate (¥/$)	¥101.5/$	¥100.4/$	¥98.6/$	¥95.9/$	¥92.5/$

If Tass uses a discount rate of 8 percent for projects in the United States, what is the NPV of this project? Should Tass Co. take on this project?

Appendix A

Future Value and Present Value Tables

APPENDIX TABLES

TABLE A.1 **Future Value Factors for $1 Compounded at i Percent Per Period for N Periods**

	i									
N	**1%**	**2%**	**3%**	**4%**	**5%**	**6%**	**7%**	**8%**	**9%**	**10%**
1	1.010	1.020	1.030	1.040	1.050	1.060	1.070	1.080	1.090	1.100
2	1.020	1.040	1.061	1.082	1.103	1.124	1.145	1.166	1.188	1.210
3	1.030	1.061	1.093	1.125	1.158	1.191	1.225	1.260	1.295	1.331
4	1.041	1.082	1.126	1.170	1.216	1.262	1.311	1.360	1.412	1.464
5	1.051	1.104	1.159	1.217	1.276	1.338	1.403	1.469	1.539	1.611
6	1.062	1.126	1.194	1.265	1.340	1.419	1.501	1.587	1.677	1.772
7	1.072	1.149	1.230	1.316	1.407	1.504	1.606	1.714	1.828	1.949
8	1.083	1.172	1.267	1.369	1.477	1.594	1.718	1.851	1.993	2.144
9	1.094	1.195	1.305	1.423	1.551	1.689	1.838	1.999	2.172	2.358
10	1.105	1.219	1.344	1.480	1.629	1.791	1.967	2.159	2.367	2.594
11	1.116	1.243	1.384	1.539	1.710	1.898	2.105	2.332	2.580	2.853
12	1.127	1.268	1.426	1.601	1.796	2.012	2.252	2.518	2.813	3.138
13	1.138	1.294	1.469	1.665	1.886	2.133	2.410	2.720	3.066	3.452
14	1.149	1.319	1.513	1.732	1.980	2.261	2.579	2.937	3.342	3.797
15	1.161	1.346	1.558	1.801	2.079	2.397	2.759	3.172	3.642	4.177
16	1.173	1.373	1.605	1.873	2.183	2.540	2.952	3.426	3.970	4.595
17	1.184	1.400	1.653	1.948	2.292	2.693	3.159	3.700	4.328	5.054
18	1.196	1.428	1.702	2.026	2.407	2.854	3.380	3.996	4.717	5.560
19	1.208	1.457	1.754	2.107	2.527	3.026	3.617	4.316	5.142	6.116
20	1.220	1.486	1.806	2.191	2.653	3.207	3.870	4.661	5.604	6.727
21	1.232	1.516	1.860	2.279	2.786	3.400	4.141	5.034	6.109	7.400
22	1.245	1.546	1.916	2.370	2.925	3.604	4.430	5.437	6.659	8.140
23	1.257	1.577	1.974	2.465	3.072	3.820	4.741	5.871	7.258	8.954
24	1.270	1.608	2.033	2.563	3.225	4.049	5.072	6.341	7.911	9.850
25	1.282	1.641	2.094	2.666	3.386	4.292	5.427	6.848	8.623	10.835
30	1.348	1.811	2.427	3.243	4.322	5.743	7.612	10.063	13.268	17.449
35	1.417	2.000	2.814	3.946	5.516	7.686	10.677	14.785	20.414	28.102
40	1.489	2.208	3.262	4.801	7.040	10.286	14.974	21.725	31.409	45.259
45	1.565	2.438	3.782	5.841	8.985	13.765	21.002	31.920	48.327	72.890
50	1.645	2.692	4.384	7.107	11.467	18.420	29.457	46.902	74.358	117.390

i									
11%	**12%**	**13%**	**14%**	**15%**	**20%**	**25%**	**30%**	**35%**	**40%**
1.110	1.120	1.130	1.140	1.150	1.200	1.250	1.300	1.350	1.400
1.232	1.254	1.277	1.300	1.323	1.440	1.563	1.690	1.823	1.960
1.368	1.405	1.443	1.482	1.521	1.728	1.953	2.197	2.460	2.744
1.518	1.574	1.530	1.689	1.749	2.074	2.441	2.856	3.322	3.842
1.685	1.762	1.842	1.925	2.011	2.488	3.052	3.713	4.484	5.378
1.870	1.974	2.082	2.195	2.313	2.986	3.815	4.827	6.053	7.530
2.076	2.211	2.353	2.502	2.660	3.583	4.768	6.275	8.172	10.541
2.305	2.476	2.658	2.853	3.059	4.300	5.960	8.157	11.032	14.758
2.558	2.773	3.004	3.252	3.518	5.160	7.451	10.604	14.894	20.661
2.839	3.106	3.395	3.707	4.046	6.192	9.313	13.786	20.107	28.925
3.152	3.479	3.836	4.226	4.652	7.430	11.642	17.922	27.144	40.496
3.498	3.896	4.335	4.818	5.350	8.916	14.552	23.298	36.644	56.694
3.883	4.363	4.898	5.492	6.153	10.699	18.190	30.288	49.470	79.371
4.310	4.887	5.535	6.261	7.076	12.839	22.737	39.374	66.784	111.120
4.785	5.474	6.254	7.138	8.137	15.407	28.422	51.186	90.158	155.560
5.311	6.130	7.067	8.137	9.358	18.488	35.527	66.542	121.710	217.790
5.895	6.866	7.986	9.276	10.761	22.186	44.409	86.504	164.310	304.910
6.544	7.690	9.024	10.575	12.375	26.623	55.511	112.450	221.820	426.870
7.263	8.613	10.197	12.056	14.232	31.948	69.389	146.190	299.460	597.630
8.062	9.646	11.523	13.743	16.367	38.338	86.736	190.050	404.270	836.680
8.949	10.804	13.021	15.668	18.822	46.005	108.420	247.060	545.760	1171.300
9.934	12.100	14.714	17.861	21.645	55.206	135.520	321.180	716.780	1639.800
10.026	13.552	16.627	20.362	24.891	66.247	169.400	417.530	994.660	2297.800
12.239	15.179	18.788	23.212	28.625	79.497	211.750	542.800	1342.700	3214.200
13.585	17.000	21.231	26.462	32.919	95.396	264.690	705.640	1812.700	4499.800
22.892	29.960	39.116	50.950	66.212	237.370	807.790	2619.900	8128.500	24201.000
38.575	52.800	72.069	98.100	133.170	590.660	2465.100	9727.800	36448.000	130161.000
65.001	93.051	132.782	188.880	267.860	1469.700	7523.100	36118.000	163437.000	700037.000
109.530	163.980	244.641	363.670	538.760	3657.200	22958.000	134106.000	732857.000	
184.560	289.000	450.735	700.230	1083.600	9100.400	70064.000	497929.000		

TABLE A.2 **Present Value Factors for $1 Received at the End of N Periods, Discounted at *i* Percent Per Period**

	i									
N	**1%**	**2%**	**3%**	**4%**	**5%**	**6%**	**7%**	**8%**	**9%**	**10%**
1	.990	.980	.971	.962	.952	.943	.935	.926	.917	.909
2	.980	.961	.943	.925	.907	.890	.873	.857	.842	.826
3	.971	.942	.915	.889	.864	.840	.816	.794	.772	.751
4	.961	.924	.888	.855	.823	.792	.763	.735	.708	.683
5	.951	.906	.863	.822	.784	.747	.713	.681	.650	.621
6	.942	.888	.837	.790	.746	.705	.666	.630	.596	.564
7	.932	.871	.813	.760	.711	.665	.623	.583	.547	.513
8	.923	.853	.789	.731	.677	.627	.582	.540	.502	.467
9	.914	.837	.766	.703	.645	.592	.544	.500	.460	.424
10	.905	.820	.744	.676	.614	.558	.508	.463	.422	.386
11	.896	.804	.722	.650	.585	.527	.475	.429	.388	.350
12	.887	.788	.701	.625	.557	.497	.444	.397	.356	.319
13	.879	.773	.681	.601	.530	.469	.415	.368	.326	.290
14	.870	.758	.661	.577	.505	.442	.388	.340	.299	.263
15	.861	.743	.642	.555	.481	.417	.362	.315	.275	.239
16	.853	.728	.623	.534	.458	.394	.339	.292	.252	.218
17	.844	.714	.605	.513	.436	.371	.317	.270	.231	.198
18	.836	.700	.587	.494	.416	.350	.296	.250	.212	.180
19	.828	.686	.570	.475	.396	.331	.277	.232	.194	.164
20	.820	.673	.554	.456	.377	.312	.258	.215	.178	.149
21	.811	.660	.538	.439	.359	.294	.242	.199	.164	.135
22	.803	.647	.522	.422	.342	.278	.226	.184	.150	.123
23	.795	.634	.507	.406	.326	.262	.211	.170	.133	.112
24	.788	.622	.492	.390	.310	.247	.197	.158	.126	.102
25	.780	.610	.478	.375	.295	.233	.184	.146	.116	.092
30	.742	.552	.412	.308	.231	.174	.131	.099	.075	.057
35	.706	.500	.355	.253	.181	.130	.094	.068	.049	.036
40	.672	.453	.307	.208	.142	.097	.067	.046	.032	.022
45	.639	.410	.264	.171	.111	.073	.048	.031	.021	.014
50	.608	.372	.228	.141	.087	.054	.034	.021	.013	.009

i									
11%	**12%**	**13%**	**14%**	**15%**	**20%**	**25%**	**30%**	**35%**	**40%**
.901	.893	.885	.877	.870	.833	.800	.769	.741	.714
.812	.797	.783	.769	.756	.694	.640	.592	.449	.510
.731	.712	.693	.675	.658	.579	.512	.455	.406	.364
.659	.636	.613	.592	.572	.482	.410	.350	.301	.260
.593	.567	.543	.519	.497	.402	.328	.269	.223	.186
.535	.507	.480	.456	.432	.335	.262	.207	.165	.133
.482	.452	.425	.400	.376	.279	.210	.159	.122	.095
.434	.404	.376	.351	.327	.233	.168	.123	.091	.068
.391	.361	.333	.308	.284	.194	.134	.094	.067	.048
.352	.322	.295	.270	.247	.162	.107	.073	.050	.035
.317	.287	.261	.237	.215	.135	.086	.056	.037	.025
.286	.257	.231	.208	.187	.112	.069	.043	.027	.018
.258	.229	.204	.182	.163	.093	.055	.033	.020	.013
.232	.205	.181	.160	.141	.078	.044	.025	.015	.009
.209	.183	.160	.140	.123	.065	.035	.020	.011	.006
.188	.163	.141	.123	.107	.054	.028	.015	.008	.005
.170	.146	.125	.108	.093	.045	.023	.012	.006	.003
.153	.130	.111	.095	.081	.038	.018	.009	.005	.002
.138	.116	.098	.083	.070	.031	.014	.007	.003	.002
.124	.104	.087	.073	.061	.026	.012	.005	.002	.001
.112	.093	.077	.064	.053	.022	.009	.004	.002	.001
.101	.083	.068	.056	.046	.018	.007	.003	.001	.001
.091	.074	.060	.049	.040	.015	.006	.002	.001	
.082	.066	.053	.043	.035	.013	.005	.002	.001	
.074	.059	.047	.038	.030	.010	.004	.001	.001	
.044	.033	.026	.020	.015	.004	.001			
.026	.019	.014	.010	.008	.002				
.015	.011	.008	.005	.004	.001				
.009	.006	.004	.003	.002					
.005	.003	.002	.001	.001					

TABLE A.3 **Future Value of Annuity Factors for $1 Received Per Period for Each of N Periods, Compounded at *i* Percent Per Period**

	i									
N	**1%**	**2%**	**3%**	**4%**	**5%**	**6%**	**7%**	**8%**	**9%**	**10%**
1	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2	2.010	2.020	2.030	2.040	2.050	2.060	2.070	2.080	2.090	2.100
3	3.030	3.060	3.091	3.122	3.152	3.184	3.215	3.246	3.278	3.310
4	4.060	4.122	4.184	4.246	4.310	4.375	4.440	4.506	4.573	4.641
5	5.101	5.204	5.309	5.416	5.526	5.637	5.751	5.867	5.985	6.105
6	6.152	6.308	6.468	6.633	6.802	6.975	7.153	7.336	7.523	7.716
7	7.214	7.434	7.662	7.898	8.142	8.394	8.654	8.923	9.200	9.487
8	8.286	8.583	8.892	9.214	9.549	10.897	10.260	10.637	11.028	11.436
9	9.369	9.755	10.159	10.583	11.027	11.491	11.978	12.488	13.021	13.579
10	10.462	10.950	11.464	12.006	12.578	13.181	13.816	14.487	15.193	15.937
11	11.567	12.169	12.808	13.486	14.207	14.972	15.784	16.645	17.560	18.531
12	12.683	13.412	14.192	15.026	15.917	16.870	17.888	18.977	20.141	21.384
13	13.809	14.680	15.618	16.627	17.713	18.882	20.141	21.495	22.953	24.523
14	14.947	15.971	17.086	18.292	19.599	21.015	22.550	24.215	26.019	27.975
15	16.097	17.291	18.599	20.024	21.579	23.276	25.129	27.152	29.361	31.722
16	17.258	18.639	20.157	21.825	23.657	25.673	27.888	30.324	33.003	35.950
17	18.430	20.012	21.762	23.698	25.840	28.213	30.840	33.750	36.974	40.545
18	19.615	21.412	23.414	25.645	28.132	30.906	33.999	37.450	41.301	45.599
19	20.811	22.841	25.117	27.671	30.539	33.760	37.379	41.446	46.018	51.159
20	22.019	24.297	26.870	29.778	33.066	36.786	40.995	45.762	51.160	57.275
21	23.239	25.783	28.676	31.969	35.719	39.993	44.865	50.423	56.765	64.002
22	24.472	27.299	30.537	34.248	38.505	43.392	49.006	55.457	62.873	71.403
23	25.716	28.845	32.453	36.618	41.430	46.996	53.436	60.893	69.532	79.543
24	26.973	30.422	34.426	39.083	44.502	50.816	58.177	66.765	76.790	88.497
25	28.243	32.030	36.459	41.646	47.727	54.865	63.249	73.106	84.701	98.347
30	34.785	40.568	47.575	56.085	66.439	79.058	94.461	113.280	136.300	164.490
35	41.660	49.994	60.462	73.652	90.320	111.430	138.230	172.310	215.710	271.020
40	48.886	60.402	75.401	95.026	120.800	154.760	199.630	259.050	337.880	442.590
45	56.481	71.893	92.720	121.020	159.700	212.740	285.740	386.500	525.850	718.900
50	64.463	84.579	112.790	152.660	209.340	290.330	406.520	573.770	815.080	1163.900

i									
11%	**12%**	**13%**	**14%**	**15%**	**20%**	**25%**	**30%**	**35%**	**40%**
1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2.110	2.120	2.130	2.140	2.150	2.200	2.250	2.300	2.350	2.400
3.342	3.374	3.407	3.440	3.472	3.640	3.813	3.990	4.172	4.360
4.710	4.779	4.850	4.921	4.993	5.368	5.766	6.187	6.633	7.104
6.228	6.353	6.480	6.610	6.742	7.442	8.207	9.043	9.954	10.196
7.913	8.115	8.232	8.536	8.754	9.930	11.259	12.756	14.438	16.324
9.783	10.089	10.405	10.730	11.067	12.916	15.073	17.583	20.492	23.853
11.859	12.300	12.757	13.233	13.727	16.499	19.842	23.858	28.664	34.395
14.164	14.776	15.416	16.085	16.786	20.799	25.802	32.015	39.696	49.153
16.722	17.549	18.420	19.337	20.304	25.959	33.253	42.619	54.590	69.814
19.561	20.655	21.814	23.045	24.349	32.150	42.566	56.405	74.697	98.739
22.713	24.133	25.650	27.271	29.002	39.581	54.208	74.327	101.840	139.230
26.212	28.029	29.985	32.089	34.352	48.497	68.760	97.625	138.480	195.920
30.095	32.393	34.883	37.581	40.505	59.196	86.949	127.910	187.950	275.300
34.405	37.280	40.417	43.842	47.580	72.035	109.680	167.280	254.730	386.420
39.190	42.753	46.672	50.980	55.717	87.442	138.100	218.470	344.890	541.980
44.501	48.884	53.739	59.118	65.075	105.930	173.630	285.010	466.610	759.780
50.396	55.750	61.725	68.394	75.836	128.110	218.040	371.510	630.920	1064.600
56.939	63.440	70.749	78.969	88.212	154.740	273.550	483.970	852.740	1491.500
64.203	72.052	80.947	91.025	102.440	186.680	342.940	630.160	1152.200	2089.200
72.265	81.699	92.470	104.760	118.810	225.020	429.680	820.210	1556.400	2925.800
81.214	92.503	105.491	120.430	137.630	271.030	538.100	1067.200	2102.200	4097.200
91.148	104.600	120.205	138.290	159.270	326.230	673.620	1388.400	2839.000	5737.100
102.170	118.150	136.831	158.650	184.160	392.480	843.030	1806.000	3833.700	8032.900
114.410	133.330	155.620	181.870	212.790	471.980	1054.700	2348.800	5176.500	11247.000
199.020	241.330	293.199	356.780	434.740	1181.800	3227.100	8729.900	23221.000	60501.000
341.590	431.660	546.681	693.570	881.170	2948.300	9856.700	32422.000	104136.000	325400.000
581.820	767.090	1013.704	1342.000	1779.000	7343.800	30088.000	120392.000	466960.000	
986.630	1358.200	1874.165	2490.500	3585.100	18281.000	91831.000	447019.000		
1668.700	2400.000	3459.507	4994.500	7217.700	45497.000	280255.000			

TABLE A.4 **Present Value of Annuity Factors for $1 Received Per Period for Each of N Periods, Discounted at *i* Percent Per Period**

	i									
N	**1%**	**2%**	**3%**	**4%**	**5%**	**6%**	**7%**	**8%**	**9%**	**10%**
1	0.990	0.980	0.971	0.962	0.952	0.943	0.935	0.926	0.917	0.909
2	1.970	1.942	1.913	1.886	1.859	1.833	1.808	1.783	1.759	1.736
3	2.941	2.884	2.829	2.775	2.723	2.673	2.624	2.577	2.531	2.487
4	3.902	3.808	3.717	3.630	3.546	3.465	3.387	3.312	3.240	3.170
5	4.853	4.713	4.580	4.452	4.329	4.212	4.100	3.993	3.890	3.791
6	5.795	5.601	5.417	5.242	5.076	4.917	4.767	4.623	4.486	4.355
7	6.728	6.472	6.230	6.002	5.786	5.582	5.389	5.206	5.033	4.868
8	7.652	7.325	7.020	6.733	6.463	6.210	5.971	5.747	5.535	5.335
9	8.566	8.162	7.786	7.435	7.108	6.802	6.515	6.247	5.995	5.759
10	9.471	8.983	8.530	8.111	7.722	7.360	7.024	6.710	6.418	6.145
11	10.368	9.787	9.253	8.760	8.306	7.887	7.499	7.139	6.805	6.495
12	11.255	10.575	9.954	9.385	8.863	8.384	7.943	7.536	7.161	6.814
13	12.134	11.348	10.635	9.986	9.394	8.853	8.358	7.904	7.487	7.103
14	13.004	12.106	11.296	10.563	9.899	9.295	8.745	8.244	7.786	7.367
15	13.865	12.849	11.938	11.118	10.380	9.712	9.108	8.559	8.061	7.606
16	14.718	13.578	12.561	11.652	10.838	10.106	9.447	8.851	8.313	7.824
17	15.562	14.292	13.166	12.166	11.274	10.477	9.763	9.122	8.544	8.022
18	16.398	14.992	13.754	12.659	11.690	10.828	10.059	9.372	8.756	8.201
19	17.226	15.678	14.324	13.134	12.085	11.158	10.336	9.604	8.950	8.365
20	18.046	16.351	14.877	13.590	12.462	11.470	10.594	9.818	9.129	8.514
21	18.857	17.011	15.415	14.029	12.821	11.764	10.836	10.017	9.292	8.649
22	19.660	17.658	15.937	14.451	13.163	12.042	11.061	10.201	9.442	8.772
23	20.456	18.292	16.444	14.857	13.489	12.303	11.272	10.371	9.580	8.883
24	21.243	18.914	16.936	15.247	13.799	12.550	11.469	10.529	9.707	8.985
25	22.023	19.523	17.413	15.622	14.094	12.783	11.654	10.675	9.823	9.077
30	25.808	22.396	19.600	17.292	15.372	13.765	12.409	11.258	10.274	9.427
35	29.409	24.999	21.487	18.665	16.374	14.498	12.948	11.655	10.567	9.644
40	32.835	27.355	23.115	19.793	17.159	15.046	13.332	11.925	10.757	9.779
45	36.095	29.490	24.519	20.720	17.774	15.456	13.606	12.108	10.881	9.863
50	39.196	31.424	25.730	21.482	18.256	15.762	13.801	12.233	10.962	9.915

i									
11%	**12%**	**13%**	**14%**	**15%**	**20%**	**25%**	**30%**	**35%**	**40%**
0.901	0.893	0.885	0.877	0.870	0.833	0.800	0.769	0.741	0.714
1.713	1.690	1.668	1.647	1.626	1.528	1.440	1.361	1.289	1.224
2.444	2.402	2.361	2.322	2.283	2.106	1.952	1.816	1.696	1.589
3.102	3.037	2.974	2.914	2.855	2.589	2.362	2.166	1.997	1.849
3.696	3.605	3.517	3.433	3.352	2.991	2.689	2.436	2.220	2.035
4.231	4.111	3.998	3.889	3.784	3.326	2.951	2.643	2.385	2.168
4.712	4.564	4.423	4.288	4.160	3.605	3.161	2.802	2.508	2.263
5.146	4.968	4.799	4.639	4.487	3.837	3.329	2.925	2.598	2.331
5.537	5.328	5.132	4.946	4.772	4.031	3.463	3.019	2.665	2.379
5.889	5.650	5.426	5.216	5.019	4.192	3.571	3.092	2.715	2.414
6.207	5.938	5.687	5.453	5.234	4.327	3.656	3.147	2.752	2.438
6.492	6.194	5.918	5.660	5.421	4.439	3.725	3.190	2.779	2.456
6.750	6.424	6.122	5.842	5.583	4.533	3.780	3.223	2.799	2.469
6.982	6.628	6.302	6.002	5.724	4.611	3.824	3.249	2.814	2.478
7.191	6.811	6.462	6.142	5.847	4.675	3.859	3.268	2.825	2.484
7.379	6.974	6.604	6.265	5.954	4.730	3.887	3.283	2.834	2.489
7.549	7.120	6.729	6.373	6.047	4.775	3.910	3.295	2.840	2.492
7.702	7.250	6.840	6.467	6.128	4.812	3.928	3.304	2.844	2.494
7.839	7.366	6.938	6.550	6.198	4.843	3.942	3.311	2.848	2.496
7.963	7.469	7.025	6.623	6.259	4.870	3.954	3.316	2.850	2.497
8.075	7.562	7.102	6.687	6.312	4.891	3.963	3.320	2.852	2.498
8.176	7.654	7.170	6.743	6.359	4.909	3.970	3.323	2.853	2.498
8.266	7.718	7.230	6.792	6.399	4.925	3.976	3.325	2.854	2.499
8.348	7.784	7.283	6.835	6.434	4.937	3.981	3.327	2.855	2.499
8.422	7.843	7.330	6.873	6.464	4.948	3.985	3.329	2.856	2.499
8.694	8.055	7.496	7.003	6.566	4.979	3.995	3.332	2.857	2.500
8.855	8.176	7.586	7.070	6.617	4.992	3.998	3.333	2.857	2.500
8.951	8.244	7.634	7.105	6.642	4.997	3.999	3.333	2.857	2.500
9.008	8.283	7.661	7.123	6.654	4.999	4.000	3.333	2.857	2.500
9.042	8.304	7.675	7.133	6.661	4.999	4.000	3.333	2.857	2.500

Solutions to Odd Problems

Chapter 1

1.1. The two basic sources of funds for all businesses are debt and equity.

1.3. A profitable firm is able to generate enough cash flows from productive assets to cover its operating expenses, payments to creditors, and taxes. Unprofitable firms fail to do this, and therefore they may be forced to declare bankruptcy.

1.5. A firm should undertake a capital project only if the value of its future cash flows exceeds the cost of the project. For example, a financial manager would not invest $10,000,000 in a new production line if the future cash flows from that line are expected to produce only $9,000,000 in future cash flows. That would be like throwing $1,000,000 away.

1.7. The financial manager must make working capital decisions regarding the levels of cash and inventory to hold, the terms of granting credit (account receivables), and the firm's policy on paying accounts payable.

1.9. *Advantages*: easiest business type to start; least regulated; owners have full control; all income is taxed as personal income. *Disadvantages*: unlimited liability of proprietor; equity capital is limited to proprietor's wealth; difficult to transfer ownership.

1.11. The owners of a corporation are its stockholders, and the evidence of their ownership is represented by shares of stock.

1.13. Double taxation occurs when earnings are taxed twice. The owners of a C-corporation are subject to double taxation—first at the corporate level when the firm's earnings are taxed and then again at a personal level when the dividends they receive are taxed.

1.15. The board of directors of a corporation is responsible for serving the interests of stockholders in managing the corporation. It is possible that the interests of managers may deviate from those of their stockholders. The board's objective is to ensure that managers are acting in the best interests of the stockholders. Board duties include hiring and firing the CEO, setting CEO pay, and monitoring the investment decisions of managers.

1.17. Drawbacks include: It is difficult to determine what is meant by profits; it does not address the size and timing of cash flows (it does not account for the time value of money); and it ignores the uncertainty (risk) of cash flows.

1.19. Factors that affect the stock price include: The characteristics of the firm, the general state of the economy, economic shocks, the business environment, expected cash flows from the firm, and current stock market conditions.

1.21. If a firm's stock price falls substantially below its maximum potential price, it might attract corporate raiders. These persons look for firms that are fundamentally sound but poorly managed, so that they can buy the firm, turn it around, and sell it for a profit.

1.23. A lack of business ethics can lead to corruption, which, in turn, creates inefficiencies in an economy, inhibits the growth of capital markets, and slows the rate of overall economic growth. For example, the Russian economy has had a relatively difficult time attracting foreign investment since the fall of the Soviet Union due, in part, to corruption in the business community and local and national governments. Lower foreign investment has led to slower overall economic growth than the country might otherwise have enjoyed.

1.25. An information asymmetry exists when one party to a business transaction possesses information that is not available to the other parties in the transaction. If the parties with less information understand their relative disadvantage, they are likely to pay lower prices for the goods or services they purchase, or charge higher prices for the goods and services that they sell. This will provide the parties that have more information with greater incentives to disclose information that is not available to the other parties.

Chapter 2

2.1. The role of the financial system is to gather money from businesses and individuals who have surplus funds and channel funds to those who need them. The financial system consists of financial markets and financial institutions.

2.3. Saver-lenders are those who have more money than they need right now. The principal saver-lenders in the economy are households. Borrower-spenders are those who need the money saver-lenders are offering. The main borrower-spenders in the economy are businesses and the federal government.

2.5. Your security is marketable, but not liquid. Liquidity implies that when a security is sold, its value will be preserved; marketability does not.

2.7. Trader, Inc., is more likely to go public because of its larger size. Though the cost of SEC registration and compliance is very high, larger firms can offset these costs by the lower funding cost in public markets. Smaller companies find the cost prohibitive for the dollar amount of securities they are likely to sell.

2.9. a. secondary; **b.** secondary; **c.** primary

2.11. a. $300,000; **b.** 3.05%; **c.** $9,850,000

2.13. Financial intermediaries allow smaller companies to access the financial markets. They do this by converting securities with one set of characteristics into securities with another set of characteristics that meets the needs of smaller companies. By repackaging securities, they are able to meet the needs of different clients.

2.15. Money markets are markets where short-term debt instruments with maturities of less than one year are bought and sold. Capital markets are markets where equity securities and debt instruments with maturities of more than one year are sold.

2.17. Treasury bills, bank negotiable CDs, and commercial paper.

2.19. The strong-form of market efficiency states that all information is reflected in the security's price. In other words, there is no private or inside information that, if released, would potentially change the price. The semistrong-form of market efficiency holds that all public information available to investors is reflected in the security's price. Therefore, insiders with access to private information could potentially profit from trading on this information before it becomes public. Finally, the weak-form of market efficiency holds that there is both public and private information that is not reflected in the security's price and having access to it can enable an investor to earn abnormal profits.

2.21. Yes. The last sentence in the Problem 2.20 problem statement suggests why this might happen. If, on the same day of the announcement, some very bad news about the future prospects for Zippy became public or if the market went down substantially, Zippy's stock price might also have gone down despite the positive sales and earnings announcement.

2.23. Public markets are organized financial markets where the public buys and sells securities through their stockbrokers or other brokers or dealers. The SEC regulates public securities markets in the United States. In contrast, private markets involve direct transactions between two parties. These transactions lack SEC regulation.

2.25. The real rate of interest measures the return earned on savings, and it represents the cost of borrowing to finance capital goods. The real rate of interest is determined by the interaction between firms that invest in capital projects and the rate of return they expect to earn on those investments, and individuals' time preference for consumption. The real rate of interest is determined when the desired level of savings equals the desired level of investments in the economy.

2.27. The Fisher equation is an equation that shows how the expected annualized change in prices (ΔP_e) is related to the nominal and real rates of interest. It is used to determine the nominal rate that protects the buying power of a lender's money from changes in inflation. It is also used to determine the interest rate, by subtracting ΔP_e from the nominal interest rate, that would exist in the absence of inflation.

2.29. Yes. The CD will be worth $1,067.50 at the end of the year, and the price of the trip will be $1,066.

Chapter 3

3.1. The balance sheet for Elkridge Sporting Goods is:

Assets	Book Value
Cash and marketable securities	$ 25,135
Accounts receivable	43,758
Inventories	167,112
Total current assets	$236,005
Net fixed assets	325,422
Other assets	13,125
Total assets	$574,552
Liabilities and Stockholders Equity	**Book Value**
Accounts payables	$ 67,855
Notes payables	36,454
Total current liabilities	$104,309
Long-term debt	223,125
Common stock	150,000
Retained earnings	97,118
Total liabilities and stockholders' equity	$574,552

The firm's retained earnings were $97,118.

3.3. FIFO makes sense during times of rising prices (inflationary times) because it allows the firm to eliminate the lower-priced inventory first, which results in higher profit margins.

3.5. $6,655,610

3.7. The company's net income is $242,401.25. The income statement is as follows:

Oakland Mills Company
Income Statement
For the period ended on March 31, 2017

	Amount
Revenues	$1,450,000.00
COGS	812,500.00
EBITDA	$ 637,500.00
Depreciation	175,000.00
EBIT	$ 462,500.00
Interest	89,575.00
EBT	$ 372,925.00
Taxes (35%)	130,523.75
Net income	**$ 242,401.25**

3.9. −$132,085

3.11. Noncash expenses are expenses identified on income statement that did not result in cash flows. Depreciation and amortization are examples of such expenses. Other noncash expenses include deferred taxes, deferred wages, and prepaid expenses.

3.13. $284,115

3.15. The **average tax rate** is the total taxes paid divided by taxable income. The **marginal tax rate** is the tax rate that is paid on the last dollar of income earned, or the rate that will be paid on the next dollar earned.

3.17. $502,838

3.19. $153,470

3.21. $137,263

3.23. $1,804,546

3.25. $620,878

3.27. $218,364; 34%; 34%

3.29. $715,720

3.31. $198,152

3.33. CFNWC = −$16,467
CFLTA = $291,401

Chapter 4

4.1. The quick ratio provides a better measure of liquidity because it includes only the most liquid of the current assets.

4.3. $1,627,579

4.5. 2.873 times; 127.0 days

4.7. 2.65; 0.623; 29.9%

4.9. 29.93%

4.11. **a.** Trademark is not doing as well as its peers. The total asset and inventory turnover ratios indicate that the firm either needs to increase its sales relative to its level of total assets and inventory or reduce its total assets and inventory relative to its level of sales. In addition, the lower quick ratio indicates that Trademark has less liquidity. The higher DSO indicates that accounts receivable are relatively high.
b. Average industry ratios serve as benchmarks that management can use to assess a firm's performance. While no two

firms are identical in any industry, the average ratios across an industry are generally good target ratios for a firm.

4.13. 1.34

4.15. $3,825,000

4.17. $843,863

4.19. 1.27; 2.27

4.21. 51.2%; 19.1%; 12.6%

4.23. 0.41; 36.02%; 18.32%; 25.84%

4.25. 34.4 times

4.27. $6,473,600; 5.7%

4.29. $10,226,559; $88,236,057; 81.6%

4.31. Current ratio = 0.77; quick ratio = 0.57; gross margin = 51.2%; net profit margin = 12.6%; debt ratio = 0.70; long-term debt to equity = 0.73; interest coverage = 20.6; ROA = 11.4%; ROE = 37.5%

4.33. Net profit margin = 12.61%; total asset turnover = 0.90; equity multiplier = 3.30; return on equity = 12.61% × 0.90 × 3.30 = 37.5%

4.35. $292,756.63

4.37. Current ratio = 1.81; quick ratio = 1.19; inventory turnover = 3.50; accounts receivable turnover = 5.16; DSO = 70.76; total asset turnover = 1.23; fixed asset turnover = 7.15; total debt ratio = 0.63; debt-to-equity ratio = 1.72; equity multiplier = 2.72; times interest earned = 17.56; cash coverage = 25.94, gross profit margin = 0.36; net profit margin = 0.08; ROA = 0.10; ROE = 0.27

Chapter 5

5.1. $53,973.12

5.3. $6,712.35

5.5. $3,289.69

5.7. **a.** $154,154.24; **b.** $154,637.37; **c.** $154,874.91; **d.** $154,883.03

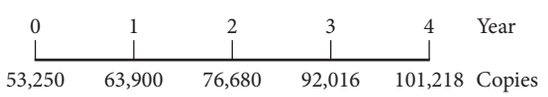
5.9. $16,108.92

5.11. $6,507.05

5.13. $734.83

5.15. 7.42%; you should borrow from the bank.

5.17. 92,016 copies; 101,218 copies



5.19. 1,045 members

5.21. **a.** $2,246.57; **b.** $2,073.16; **c.** $2,946.96; **d.** $2,949.88

5.23. 11 years

5.25. 3.8 years

5.27. 10.42%

5.29. The present value of $2,100 is $1,869. Since $1,869 is greater than $1,820, Caroline should wait two years unless she needs the money sooner.

5.31. 13.96%

5.33. Option 1 (mutual fund): $26,803.77; Option 2 (brother's business): $23,579.48; you should choose the mutual fund.

5.35. Option A: $6,922,647; Option B: $6,983,894; Option C: $7,083,096; Jared should choose Option C.

5.37. 13.14%

Chapter 6

6.1. $74,472.48

6.3. $3,185.40

6.5. $5,747.40

6.7. $5,652.06

6.9. $247,609.95

6.11. $1,361,642.36

6.13. $4,221.07

6.15. **a.** $15,000; **b.** $6,000; **c.** $10,000

6.17. 7%

6.19. $6,144,462.11

6.21. $1,496,377.71

6.23. $1,193,831.54

6.25. $7,000,000

6.27. $2,958,662.16

6.29. **a.** $17,857.14; **b.** $114,533.97; **c.** $4,250.00

6.31. **b.** has the highest EAR (8.57%)

6.33. $20,495.15

6.35. $3,971.94

6.37. 5%

6.39. **a.** $1,906,071.48; **b.** $2,272,554.25; **c.** $212,889.63; **d.** $181,804.34

6.41. $2,048.27

Chapter 7

7.1. A holding period return is the total return over some investment or "holding" period. It consists of a capital appreciation component and an income component. A holding period return reflects past performance. An expected return is the probability-weighted average of the possible returns from an investment. It describes a possible return (or even a return that may not be possible) for a yet-to-occur investment period.

7.3. Expected salary: $66,000; standard deviation: $78,000

7.5. Stock B

7.7. 0.1535

7.9. Risk that cannot be diversified away is *systematic risk*. It is the only type of risk that exists in a diversified portfolio, and it is the only type of risk that is rewarded in asset markets.

7.11. Since the beta of any asset is the slope of the line of best fit for the plot of the asset's return against the market return, we can use that relation to help us understand the beta of a T-bill. If we purchased a T-bill five years ago and held that T-bill through each of the last 60 months, then the return for each of those 60 months would be exactly the same. Therefore, the vertical axis coordinates of each of the monthly returns would have the same value, and the slope (beta) of the line of best fit would be zero. The meaning of a beta of zero means that our T-bill has no systematic risk. That makes sense given that we know that a T-bill has no risk at all since it is a riskless asset.

7.13. The CAPM is a model that describes the relation between systematic risk and the expected return. The model tells us that the expected return on an asset with no systematic risk equals the risk-free rate. As systematic risk increases, the expected return increases linearly with beta. The CAPM is written as $E(R_i) = R_{rf} + \beta_i[E(R_m) - R_{rf}]$.

7.15. $1,250

7.17. 0.145; 0.162

7.19. 0.125; 0.168

7.21. $\sigma_{1,2} = 0.12, 0.1225$; $\sigma_{1,2} = 0, 0.0625$; $\sigma_{1,2} = -0.12, 0.0025$

7.23. Your portfolio contains no unsystematic risk, but it does contain systematic risk. Therefore, the market should compensate the holder of this portfolio for the systematic risk that the investor bears. A risk-free security has no risk, and therefore requires no compensation for risk bearing. The expected return of your portfolio should therefore be greater than the return from the risk-free security.

7.25. The statement is false. Even if we could afford such a portfolio and thus completely diversify our portfolio, we would only be eliminating unsystematic risk. The systematic risk associated with the portfolio would remain. Otherwise, the expected rate of return on the market portfolio would be equal to the risk-free rate of return. We know that to be a false statement.

7.27. 0.0891

7.29. 0.185; 0.165

7.31. 0.19

7.33. If we assume that all investors will seek to be compensated (generate returns) for the level of risk that they are bearing, then we can see that undiversifi ed investors will require a greater return for a given investment than diversifi ed investors will. Given that, we can see that diversifi ed investors will be willing to pay a greater price for an asset than undiversifi ed investors. Therefore, the diversified investor is the marginal investor whose purchase will determine the equilibrium price, and therefore the equilibrium return for an asset.

7.35. The first security is underpriced, and the second is overpriced. With the underpriced security, investors will purchase the security until its price increases to the point where it is no longer underpriced. With the overpriced security, investors will sell the security and drive its price down.

7.37. $\sigma_{RA} = 0.06$; $\beta_B = 2.25$; $\rho_{RC,M} = 1.00$; $\rho_{RM,M} = 1.00$; $\beta_M = 1.00$; $\rho_{RT\text{-}bill,M} = 0$; $\beta_{T\text{-}bill} = 0$

$E(R_A) = 0.125$; $E(R_B) = 0.1625$; $E(R_C) = 0.075$

A comparison of the expected returns that are given in the problem statement, with the returns that CAPM predicts (which are presented above), indicates that you should buy stocks A and C and avoid stock B.

Chapter 8

8.1. $1,147.20

8.3. $1,008.15

8.5. $975.91

8.7. $359.38

8.9. 6.58%

8.11. 9.52%

8.13. $1,000

8.15. $912.61; 1,370 bonds

8.17. $1,079.23

8.19. 12.45%

8.21. 7.33%; 7.36%

8.23. 11.49% (EAY = 11.81%)

8.25. 8.65% (EAY = 8.84%)

8.27. **a.** $924.75; **b.** 9.67% (EAY = 9.90%)

8.29. **a.** $904.76; **b.** $1,086.46, $832.53

c. Bond prices decrease when interest rates go up and increase when interest rates go down.

d. $1,063.42, $866.65

8.31. **a.** $25

b. The stock price would have to increase by two standard deviations ($2 \times \$5 = \$10$) for the price to increase to $25 and for conversion to become attractive to the investors. From Chapter 7 we know that 95% of possible outcomes fall within 1.96 standard deviations of the mean (average) value in a normal distribution. This means that there is approximately a 5 percent chance that the stock price will move up or down by $10 or more. Since the normal distribution is symmetric, this means that there is only a 2.5 percent chance that Zippy's stock price will increase enough for it to become attractive for the investors to exercise the conversion option in the next year.

Chapter 9

9.1. A stock market index is an index used to measure the performance of a stock market. These indexes reflect the value of stocks in a particular market, such as the NYSE or the NASDAQ, or across markets, and they increase and decrease as the values of the stocks go up and down. Examples of stock market indexes include the Dow Jones Industrial Average, the New York Stock Exchange Index, the Standard & Poor's 500 Index, and the NASDAQ Composite Index.

9.3. National Association of Securities Dealers Automated Quotation system. NASDAQ is one of the world's largest electronic markets, listing over three thousand companies.

9.5. $14.24

9.7. $27.38

9.9. $8.50

9.11. $31.12

9.13. 12.15%

9.15. $56.90

9.17. $2.46

9.19. $21.07

9.21. $5.15

9.23. $23.35

9.25. $32.34

9.27. $25.95

9.29. $2.15

9.31. $73.94

9.33. **a.** $34.45

b. No, she should not buy more shares. This stock is overpriced with the stock selling at a higher price than it is worth. She should sell her shares.

9.35. **a.** $6.37; **b.** $62.03; **c.** $48.24

9.37. **a.** $2.41; **b.** $37.86; **c.** $20.67

d. No, the length of the holding period has no bearing on today's stock price.

Chapter 10

10.1. $62,337

10.3. Yes; NPV = $134,986.

10.5. Blanda should invest in System 2. The NPV of System 1 is $22,969.42, and the NPV of System 2 is $36,001.43.

10.7. 2.87 years

10.9. 3.45 years

10.11. 33.8%

10.13. The profitability index is computed as the ratio of NPV plus initial investment divided by initial investment. In the capital rationing process, we can calculate the profitability index for each potential investment and choose the projects with the largest indexes until we run out of capital. This follows the basic principle that we need to choose the set of projects that creates the greatest value given the limited capital available.

10.15. −$351,223

10.17. System 200 should be chosen. NPV = $75,758 for System 200 and NPV = −$56,667 for System 100.

10.19. The discounted payback periods for the projects are: Project A = 4+ years; Project B = 3+ years. Since the firm's acceptance criteria is three years, neither project will be accepted.

10.21. 4.19 years

10.23. 17.4%

10.25. System 1 IRR = 83.93%; System 2 IRR 50.07%. System 1 NPV = $22,969.42; System 2 NPV = $36,001.43. System 1 delivers a higher IRR because it requires a lower initial investment and the cost is recovered the first year. Thus, even with lower cash inflows in the years after start-up, System 1 is able to deliver a higher return on the initial investment. System 2 has a higher initial investment but delivers a higher net cash flow for the firm.

10.27. a. 6.97%; **b.** 13.3%; **c.** 14.2%

10.29. Compute the profitability index for each of the projects. PI_A = 1.50; PI_B = 1.64; PI_C = 1.56; PI_D = 1.57. With $30,000, you should invest in B, D, and C. The total cost is $27,000, and the total NPV is $16,000.

10.31. NPV of Project 1 = −$668,283 (reject); NPV of Project 2 = $375,375 (accept)

10.33. At 14.8%, only Project 2 will be accepted (NPV = $118,353). At 13.6%, Projects 2 and 3 will be accepted (NPVs of $141,295 and $1,491, respectively).

10.35. Project 1 should be accepted. Its NPV = $186,683 and its IRR = 20.1%. Project 2 has NPV = −$76,796 and IRR = 12.4%.

10.37. Project 1 = 16.1%; Project 2 = 13.7%; Project 3 = 10.9%

10.39. a. 5.45 years; **b.** 4.1%; **c.** −$2,043,927; **d.** 3.1%

10.41. a. A = $147,891, B = $166,553; **b.** A = 27.2%, B = 26.1%; **c.** Both should be accepted under the NPV and IRR decision criteria; **d.** Both projects will be accepted. They are independent and both have a positive NPV.

10.43. NPV_x = $2,650.78; NPV_y = $2,189.06; PI_x = 1.1325; PI_y = 1.1095. Both methods rank Project X over Project Y. However, both projects should be accepted under the NPV criteria. Therefore, both should be accepted if they are independent and sufficient resources are available. If the projects are mutually exclusive, the project with the higher NPV or PI, which in this case is Project X, should be chosen.

10.45. c. Discounted payback period is 1.01 years longer than the payback period.

10.47. d. IRR = 28.79%

Chapter 11

11.1. The main reason is that accounting earnings generally differ from free cash flows, and free cash flows are what stockholders care about.

11.3. Subtract depreciation from EBITDA, multiply by (1 – tax rate), and add back depreciation. This enables us to account for the fact that depreciation reduces the taxes that must be paid.

11.5. The average tax rate is the total tax paid divided by total earnings, while the marginal tax rate is the rate paid on the last dollar earned. Use the marginal tax rate when calculating incremental after-tax free cash flows.

11.7. Variable costs vary directly with the number of units of output. Fixed costs do not vary with the number of units.

11.9. $9,009.60

11.11. $1,370

11.13. The equivalent annual cost (EAC) is the annual payment from an annuity that has a life equal to that of a project and that has the same NPV as the project. EAC values for two projects with different lives can be directly compared to determine which project has a lower cost per year.

11.15. The alternative to using the Equivalent Annual Cost concept is to assume that each of the projects is repeated the number of times necessary for the number of years they produce cash flows to be equal. In this problem you would assume that the five-year project was repeated six times and the six-year project was repeated five times. This effectively makes each of these projects a 30-year project. You then can use standard NPV analysis to choose between the two.

11.17. You should invest in Bond A because it pays a higher nominal interest rate.

11.19. The cash flow related to working capital at the beginning of the project is: $10,000 + $30,000 + $25,000 − $5,000 = $60,000.

The present value of the cash flow related to working capital at the end of the project is: $60,000/$(1 + 0.12)^{10}$ = $19,318.39.

11.21. NPV = $718,056.94

11.23. You should buy Model A because it has a lower EAC (−$2,866.47 vs. −$2,978.44).

11.25. Bell Mountain should buy the system in Year 3.

11.27. The optimal time to replace the old car is at the end of Year 2.

11.29. −$4,558.70

11.31. P = $107.74 per shovel

11.33. $10,410,000

11.35. Biotech should sell its bacteria colony at the beginning of the third year (or at the end of the second year).

11.37. Renovating the old line is less costly.

Chapter 12

12.1. Variable costs vary with the number of units of output. Fixed costs do not vary with the number of units.

12.3. Yes. EBIT is $375,000 with the new technology and $250,000 with the old.

12.5. 1.392

12.7. The degree of accounting operating leverage can be used to tell us how much a firm's EBIT will change for a given change in revenue. For example, if the firm's accounting operating leverage is 3, then a 15 percent increase in revenue will result in a 45 percent (15 percent × 3 = 45 percent) increase in EBIT for the firm.

12.9. We must know the difference between unit price and unit variable cost (the per-unit contribution) in order to determine how many units must be sold to pay a firm's fixed costs.

12.11. The economic break-even point.

12.13. Since depreciation and amortization is a noncash item, the manufacturing firm is more likely to have a discrepancy between its FCF and EBIT.

12.15. Specialty should produce and sell the bulbs because EBIT for the additional bulbs is positive (EBIT = $1,000).

12.17. 15.9%

12.19. 340,000 candles

12.21. While the business may be expected to have an accounting operating loss, our focus should be on the expected operating cash flow. A business can produce an accounting operating loss at the same time it produces positive operating cash fl ow income because the depreciation and amortization charges are not subtracted in the calculation of operating cash fl ow. Since depreciation and amortization are noncash charges, the project could still be viable if it does not have negative operating cash.

12.23. $4,651.67

12.25. Scenario analysis is a more realistic method because it accounts for the fact that changes in key variables are often related and that they therefore can change at the same time.

12.27. A 10 percent increase in the price of a bottle will increase FCF from $38,000 to $46,400.

12.29. 1.67

12.31. A 10 percent increase in revenue will result in a 20 percent increase in EBITDA.

12.33. The fi rm with the higher fixed cost structure should have the lower variable cost per unit, assuming there is a trade-off . A lower variable cost per unit would result in a higher contribution margin.

12.35. No. The project NPV = −$298,110.03.

Chapter 13

13.1. $98 million

13.3. When we calculate the cost of debt for a U.S. fi rm, we must take into account the tax subsidy given in the United States for interest payments on debt. For every dollar the fi rm pays in interest, the fi rm's tax bill will decline by ($1 × t), where t is the fi rm's marginal tax rate. We adjust for this tax benefi t by multiplying the pretax cost of debt by $(1 - t)$. This calculation gives us the after-tax cost of debt. We use the after-tax cost of debt for cost of capital calculations such as when we calculate the WACC.

13.5. 16%

13.7. 10%

13.9. 15.8%

13.11. 9.4%

13.13. The owners of all of the securities that have been sold to finance a fi rm, collectively, own all of the cash flows that the assets of the firm generate. The value of these securities must equal the value of these cash flows and, therefore, the value of the firm.

13.15. $1,000

13.17. 7.7%

13.19. 4.63%, 6.27%

13.21.
$$P_{cs} = \frac{D_1}{1+k_{cs}} + \frac{D_1(1+g_1)}{(1+k_{cs})^2} + \frac{D_1(1+g_1)^2}{(1+k_{cs})^3} + \frac{D_1(1+g_1)^3}{(1+k_{cs})^4} + \frac{D_1(1+g_1)^4}{(1+k_{cs})^5} + \frac{D_1(1+g_1)^4(1+g_2)}{(k_{cs}-g_2)(1+k_{cs})^5}$$

It is easy to see that in order to solve for a cost of capital, k_{cs}, you must have a good idea of what g_1 and g_2 are. If the estimates for those growth rates are poor, then the calculation for k_{cs}, will also yield a poor estimate.

13.23. Markets adjust the cost of capital according to the level of systematic risk in a project. Therefore, the project with the greatest level of systematic risk will have the greatest positive impact on the cost of capital for the firm, even if it has the lowest level of unsystematic risk.

13.25. Since Imaginary will be financing the project with the same mix of capital that the firm is currently utilizing for its projects, it will have satisfied the condition concerning financing mix. In addition, the new project will have the same degree of systematic risk (in addition to being in the same general line of business) as the average project in the firm. Therefore, Imaginary management can use the firm's 9.26 percent cost of capital to evaluate this project.

13.27. While the growth in dividends has been extremely constant for MacroSwift over the last 15 years, it is appropriate to assume a constant-growth rate only if that same rate is expected to continue in the future. Two factors will act to alter that growth in the future. MacroSwift will have competition for its current products in the near future, and that could alter the firm's growth rate. In addition, the firm is expanding its product line into an area that will probably not yield the same level of growth. It is, therefore, unlikely that MacroSwift's dividend growth rate will continue at a 3 percent annual rate. This suggests that you should consider something other than constant growth in your modeling.

13.29. 12.35%

13.31. 9.78%

13.33. Expected returns are impounded in market prices and reflect the information that investors have about the values of securities. Since the market adjusts security prices to reflect the expected returns for investing in securities, ignoring that information by using book values is the same as ignoring what the market deems to be an appropriate cost of capital for the firm.

13.35. Since, collectively, the debt and equity holders are entitled to receive all of the cash flows that the assets of the firm are expected to produce, the systematic risk of the cash flows that they are entitled to receive must be the same as the systematic risk of the cash flows the assets are expected to produce.

13.37. 7.60%

Chapter 14

14.1. Wolfgang's cash conversion cycle is 69 days. Since this is less than the industry average of 75 days, the firm is more efficient than the average firm in the industry in managing its working capital.

14.3. −3 days; the amount of time Devon takes to turn over its inventory and to collect its receivables is less than the amount of time Devon takes to pay its suppliers.

14.5. 73 days

14.7. Risks associated with a restrictive current asset management strategy arise from exposure to either financial or operating shortage costs. Financial costs are associated with a sudden and unforeseen loss of liquidity that makes it difficult for a firm to repay its current liabilities. In this situation, a firm may be forced to rely on costly external emergency borrowing, or if such funds can't be secured, the firm may default on its loan obligations. Operating shortage costs result from lost production or sales that occur if the firm does not have sufficient raw material or finished goods. Operating shortage costs can also occur if a firm's credit policies are too restrictive and discourage a significant number of potential customers from purchasing its products.

14.9. 34.72%

14.11. $626.91

14.13. 11.6%

14.15. 6.48%

14.17. 89.3 days, 198.2 days

14.19. $267,222

14.21. $47,361

14.23. $287,671

14.25. 16 orders

14.27. 8.775%

14.29. 5.54%

14.31. $9,324

14.33. 14.9%, 28.2 days. Lincoln's effective days' sales outstanding is approximately seven days less than the industry average.

14.35. $7,500; 37.1%

14.37. **a.** Increase, Increase; **b.** Increase, Increase; **c.** No change, Decrease; **d.** Increase, Increase; **e.** Increase, No change

14.39. **a.** 67.9 days; **b.** 80.6 days; **c.** 105.7 days; **d.** 148.5 days; **e.** 42.8 days

14.41. **a.** $30,000; **b.** 63.2%; **c.** 85.06%

Chapter 15

15.1. As noted in Footnote 1, business plans (and their contents) are discussed in detail in Chapter 18. As explained in this chapter, in general terms the business plan describes (1) what you want the business to become, (2) why consumers will find your product(s) attractive (the value proposition), (3) how you are going to accomplish your objectives, and (4) what resources you will need.

15.3. Sell the business to a strategic or financial buyer, take it public, or remain a private company and sell shares privately.

15.5. Examine comparable companies and see what prices their share are trading for; A discounted cash flow analysis.

15.7. Debt issues that are complex in nature or that are issued in uncertain times are often sold through negotiated sales. This allows the underwriter to better control the conditions of the sale and to better explain the firm to potential investors, thereby keeping issue costs relatively low.

15.9. $24,308,528

15.11. The steps in a general cash offering are: (1) Decide what type of security to issue and the amount to be raised, (2) Obtain approvals, (3) File re tration statement, (4) Set offer price, and (5) Closing.

15.13. As the size of a securities issue increases, the total flotation costs per security (or dollar raised) decline.

15.15. Nalco is probably better off choosing to sell debt in the public market, given its size.

15.17. The borrowing cost will increase to 9.43%.

15.19. You can fund the project in stages. This will allow you to review the project's profitability before you commit to further financing. You can also require the entrepreneurs to invest some of their own capital, which will tie them to the project by making it more costly for them to abandon it. Finally, you can syndicate the deal. Doing this spreads the risk among multiple venture capital firms and provides corroboration regarding the reasonableness of the investment decision.

15.21. $1,220,000

15.23. $68,700,000; $15,300,000

15.25. **a.** $130,000,000; **b.** $120,500,000; **c.** $9,500,000

15.27. 6.52%; If the economy is supposed to improve (deteriorate), interest rates are likely to go up (down) in the near future. This could make the cost of borrowing more (less) expensive.

Chapter 16

16.1. The assumption that there are no information or transaction costs.

16.3. The value of the firm is independent of the proportion of debt and equity utilized to finance the firm under the Modigliani and Miller's Proposition 1 assumptions.

16.5. 20%

16.7. 18%

16.9. $150,000,000

16.11. 10.5%

16.13. 42%

16.15. Information or transaction costs would reduce the total value that is available for the debt holders and the stockholders and, therefore, the value of the firm.

16.17. $530,000,000

16.19. Lower productivity due to lower morale and job hunting and higher recruiting costs are among the costs of financial distress that the firm will incur.

16.21. The managers expect to lose their jobs in one year whether they take on the project and work hard or not. They have no incentive to take on the project. Declining it makes the shortfall to the debt holders greater, and any possible return to the stockholders smaller, than it would be if the firm followed the rule of always accepting positive NPV projects.

16.23. Given the information in the question we would expect that an increase in the marginal tax rate will increase the value of the tax shield and increase the amount of debt in the optimal capital structure.

16.25. That internally generated equity is utilized first as a source of financing does not mean that the internally generated funds are cheaper than debt. Internally generated funds belong to stockholders and are therefore really equity financing, which we know to be more expensive than debt.

16.27. Under these conditions, the value of the firm will increase with the amount of debt financing that is used due to the interest tax shields. The conservative approach will not maximize firm value.

16.29. $810,000,000

16.31. If enough debt is used to finance this firm, then the challenges of ensuring that the firm produces enough cash to make interest and principal payments would provide managers of the firm with incentives to work on new positive NPV projects rather than spend their Fridays in Cancun.

16.33. $3,000,000; $250,000; k_{cs} and WACC before restructuring both equal 10%; after restructuring $k_{cs} = 11.33\%$ and WACC = 9.23%.

Chapter 17

17.1. This reduction could indicate that management expects a lower level of profitability in the future (negative signal). It could also indicate that Poseidon requires additional money to invest in positive NPV projects that were not previously available (positive signal).

17.3. The proper chronological order is: (1) Declaration date, (2) Ex-dividend date, (3) Record date, (4) Payment date.

17.5. Any cash paid to stockholders through a dividend reduces the value of the assets that remain in the firm to secure the creditors' claims.

17.7. $9.75

17.9. With a stock repurchase, stockholders can decide whether to participate. It they choose to participate, there is a tax advantage for the stockholders, relative to the tax treatment of a dividend. A dividend payment forces the stockholders to receive cash and recognize associated tax implications. Also, with a stock repurchase the stockholder only pays tax on the gain from the sale. With a dividend the stockholder pays tax on the full amount of the dividend.

17.11. Relaxing the no transaction cost assumption increases the cost of producing a homemade dividend (or the cost of undoing unwanted dividends). This makes a firm's dividend policy a relevant factor when valuing its shares.

17.13. The value of dividend-paying stocks should decrease relative to the value of non-dividend-paying stocks because the after-tax cash flows from the dividend-paying stocks will go down.

17.15. Reducing a dividend may indicate that a firm does not have sufficient cash, which would be a negative signal. On the other hand, when a high-growth firm increases its dividend, the increase may be interpreted as indicating that the firm has fewer positive NPV projects and that its growth rate will decline, which is also a negative signal.

17.17. You would probably prefer that the firm initiate a stock repurchase. You can opt not to sell your shares to the firm but still participate in the increased value of the firm's shares since your pro-rata share of the expected future cash flows generated by the firm will increase. You would probably not prefer a dividend payment since you would then be required to receive the cash if you were the registered owner of the shares on the record date.

17.19. Assuming that managers are acting to maximize firm value, any time they are repurchasing shares they must be doing so because they believe that the firm's shares are undervalued and that repurchasing shares is a positive NPV project. In repurchasing the shares, management is utilizing inside information to take advantage of the sellers of those shares in a way that benefits the remaining stockholders of the firm. Consequently, management is not doing something in the interest of all stockholders. Stockholders who sell will be selling at a lower price than they could have realized had they held their shares until the inside information became public.

17.21. (1) Open-market purchase—the firm simply purchases the shares in the market, (2) Tender offer—the firm makes an offer through a general announcement, offering to buy up to a certain number of shares from anyone who wishes to sell, (3) Targeted stock repurchase—the firm directly negotiates with an individual stockholder to buy shares from that individual. Exhibit 17.3 presents data on stock price reactions.

17.23. The purpose of setting the ex-dividend date before the record date is to allow time for a sale of securities to be completed and recorded before the record date. Since the settlement period was reduced from five days to two days, we should also have seen the number of days between the ex-dividend date and the record date reduced, which we did.

17.25. Paying a dividend reduces the value of equity and thereby increases the debt-to-total-capital ratio in a levered firm.

17.27. $15

17.29. $72,500

17.31. $150,000

17.33. Ultimately, the best decision will depend on a comparison of the advantages and disadvantages of a special dividend and a share repurchase, in view of the characteristics of your company and your objectives. If speed is a primary concern, a special dividend is likely to be your only choice. On the other hand, if speed is not a primary concern, a share repurchase might be more appropriate.

Chapter 18

18.1. The forms of organizations discussed in this chapter include: Sole Proprietorship, Partnership (General Partnership and Limited Partnership), Corporation (S-Corporation and C-Corporation), and Limited Liability Partnership (LLP) and Company (LLC). The access to capital for each is summarized in Exhibit 18.1.

18.3. With sole proprietors and general partners, there is the possibility that personal assets can be taken to satisfy claims on the business. In contrast, the liabilities of investors in LLPs, LLCs, and corporations are generally limited to the money that they have invested in the business.

18.5. Equity capital can be obtained from friends and family, venture capitalists, or other potential investors that you know. Debt capital can be obtained from bank loans, cash advances on credit cards, or loans from other individual investors or other businesses. Once the company is large enough, equity and debt financing can be obtained in the public markets.

18.7. The replacement cost of a business is the cost of replacing the assets of the business in their present form.

18.9. Excess cash is a nonoperating asset because this cash can be distributed to stockholders without affecting the operations of the business and therefore the value of the expected free cash flows from the firm. It makes sense to add back the value of excess cash because it represents value over and above that which the operating assets of the business are expected to produce.

18.11. Probably not. The private shares are relatively illiquid and the value would be discounted for this lack of liquidity in the market.

18.13. A Limited Liability Company (LLC) is a hybrid of a C-corporation and a partnership. It has the limited liability of a C-corporation with the tax advantages of a partnership.

18.15. Break-even point for TV option = 1,250 units per year. Break-even point for flyer option = 150 units per year. Choose the flyer option.

18.17. $1,573.64 million

18.19. The enterprise value/EBITDA multiple is more appropriate since the capital structures of Johnson and Billy's differ considerably.

18.21. $12,675,000

18.23. It is not adequate. $9,400 of additional capital will be required up-front. $89,400 is needed to maintain a $5,000 cash balance. The monthly break-even points for the firm are: 4,333.3 bottles in the initial month and 1,833.3 bottles in the following months.

18.25. See the key elements of a business plan in Section 18.2.

18.27. The company has a short history, high investments, no sales, and highly uncertain future cash flows. The cost approach is not valid for such a young biochemical company; it is hard to value the company using multiples because of the lack of sales and negative earnings, and because of a lack of comparable public companies. The transaction approach is also likely to be difficult to apply due to the difficulty of finding a comparable transaction. Despite the many uncertainties, we should try to estimate the future free cash flows and the risks associated with these cash flows and use the FCFF approach to value it.

18.29. 7.115%

18.31. V_E = $354,849; Your friend should receive 9.88 percent of the equity.

Chapter 19

19.1. The strategic plan is the blueprint for a company's management that drives all decision making within the firm across all areas of its operations.

19.3. The financing plan identifies external funding needed, sources of funding, target capital structure, and payout policy.

19.5. The important elements of financial modeling are sales and cost forecasts, investment decisions, financing requirements and choices, and pro-forma statements.

19.7. $52,686; 55%

19.9. Net sales $1,710; Costs $399; Net income $1,311

19.11. The capital intensity ratio measures the amount of assets needed to generate $1 in sales. It tells us how much a firm must invest in assets to support a given level of sales.

19.13. 68.02%

19.15. 6.8%

19.17. Exhibit 19.11 gives you the plot.

19.19. The electric utilities industry and the aluminum processing industry are examples of capital-intensive industries.

19.21. 34.25%

19.23. 8.2%

19.25. 9.9%

19.27. 5.2%

19.29. $1,008,381; 44.27%

19.31. 9.6%

19.33. 27.4%

19.35.

Morgan Construction Company—Pro Forma Balance Sheet for June 30, 2018							
	2017		2018		2017		2018
Cash	$ 3,349,239	1.25	$ 4,186,548	Accounts payable	$ 9,041,679	1.25	$11,302,098
Accounts receivable	5,830,754	1.25	7,288,442	Notes payable	4,857,496	1.25	6,071,869
Inventories	22,267,674	1.25	27,834,593	Total current liabilities	$13,899,174		$17,373,968
Total current assets	$31,447,666		$39,309,583	Long-term debt	29,371,406		37,164,258
Net fixed assets	43,362,482	1.25	54,203,102	Common stock	19,987,500	1.25	24,984,375
Other assets	1,748,482	1.25	2,186,133	Retained earnings	12,940,974	1.25	16,176,217
Total assets	$76,559,054		$95,698,818	Total liabilities & equity	$76,559,054		$95,698,818

Morgan Construction Company Pro Forma Income Statement for the Fiscal Year Ended June 30, 2018			
	2017		2018
Net sales	$193,212,500	1.25	$241,515,625
Costs	145,265,625	1.25	181,582,031
EBITDA	$ 47,946,875		$ 59,933,594
Depreciation	23,318,750	1.25	29,148,438
EBIT	$ 24,628,125		$ 30,785,156
Interest	11,935,869	1.25	14,919,836
EBT	$ 12,692,256		$ 15,865,320
Taxes (35%)	4,442,290	1.25	5,552,862
Net income	$ 8,249,967		$ 10,312,458

19.37. 3.37%; 6.26%

19.39. **a.** 8.16%; **b.** 13.86%; **c.** $4,777,333; **d.** See the following financial statements.

Munson Communications Company—Pro Forma Balance Sheet for June 30, 2018							
	2017		2018		2017		2018
Cash	$ 1,728,639	1.20	$ 2,074,367	Accounts payable	4,666,673	1.20	$ 5,600,007
Accounts receivable	3,009,421	1.20	3,611,305	Notes payable	2,507,094	1.20	3,008,513
Inventories	11,492,993	1.20	13,791,592	Total current liabilities	$ 7,173,767		$ 8,608,521
Total current assets	$16,231,054		$19,477,264	Long-term debt	13,345,242		16,687,821
Net fixed assets	22,380,635	1.20	26,856,763	Common stock	10,165,235		10,165,235
Other assets	1,748,906	1.20	2,098,688	Retained earnings	9,676,351		12,971,137
Total assets	$40,360,595		$48,432,714	Total liabilities & equity	$40,360,595		$48,432,714

Munson Communications Company Pro Forma Income Statement for the Fiscal Year Ended June 30, 2018			
	2017		2018
Net sales	$79,722,581	1.20	$95,667,097
Costs	59,358,499	1.20	71,230,199
EBITDA	$20,364,082		$24,436,898
Depreciation	7,318,750	1.20	8,782,500
EBIT	$13,045,332		$15,654,398
Interest	3,658,477	1.20	4,390,172
EBT	$ 9,386,855		$11,264,226
Taxes (35%)	3,285,399	1.20	3,942,479
Net income	$ 6,101,456		$ 7,321,747

Chapter 20

20.1. An option is the right to buy or sell an asset at a prespecified price on or before a prespecified date.

20.3. $0; $15

20.5. The value of a call option increases as: (1) Current value of the underlying asset increases; (2) Exercise price decreases; (3) Volatility of the value of the underlying asset increases; (4) Time until the expiration of the option increases; or (5) Risk-free rate of interest increases.

20.7. The seller of a put option hopes that the value of the underlying asset will remain at or above the exercise price, thereby making it worth-less to the owner (buyer) of the option.

20.9. No. The losses to the seller of a call option are only limited by the extent to which the value of the underlying asset can increase. There is no other limit.

20.11. Your option is worth very slightly more than zero. There is little chance that the stock price will move above $100 by tomorrow, but the chance is not zero, so the option still has some value.

20.13. The underlying asset of a financial option is a financial asset, such as a share of stock. The underlying asset of a real option is a nonfinancial (real) asset, such as a project.

20.15. The payoff functions for lenders and stockholders are like those for different types of options. Agency costs arise because these payoff functions are different from each other.

20.17. The purchaser of a callable bond is simultaneously buying a straight (noncallable) bond and selling the issuer a call option on that bond. The total value of the callable bond equals the value of the straight bond minus the value of the option. It would be lower than the value for a straight bond.

20.19. Because option buyers pay option sellers an amount that compensates sellers for the risks that they will lose money on the option. The amount that the seller receives is known as the option premium.

20.21. $7.01

20.23. $1.18

20.25. A golden parachute can help reduce agency problems by reducing the potential cost to a manager of making decisions that stockholders want, but that could harm the manager. For example, having a golden parachute can provide a manager with stronger incentives to invest in risky projects or approve a merger that could result in the loss of his or her job.

20.27. The payoffs from these two portfolios are identical.

20.29. **a.** Both the debt and equity are worth $5 million before the investment; **b.** $6.5 million; **c.** $3.5 million

20.31. Call option #1 has a lower strike price and costs less. In a situation like this you can earn arbitrage profits by purchasing the less expensive option (#1) and selling the more expensive option (#2).

20.33. It mitigates this concern because the lenders will benefit through the call option from increased volatility in the value of the firm. How much a conversion option mitigates this concern depends on the specific characteristics of the option.

Chapter 21

21.1. $183.77

21.3. **a.** MP11.8483/$; **b.** €1.1747/£; **c.** C$0.0183/Rs

21.5. It is more expensive in New York. The cost in Berlin is $55,680.76.

21.7. $9,400

21.9. $3,040,967

21.11. **a.** There is a forward premium of (0.9960 − 0.9899)/0.9899 = 0.62% on the Swiss franc.

b. There is a forward premium of (0.008754 − 0.00872)/0.00872 = 0.39% on the Japanese yen.

c. We can expect both the Swiss franc and the Japanese yen to appreciate relative to the U.S. dollar in the next three months.

21.13. 0.573%

21.15. €1.1952/£

21.17. SK6.8761/SF

21.19. Transaction exposure is related to foreign exchange risk faced by firms that are expecting revenues in foreign currency or have expenses in foreign currency that relate to transactions they have already entered into. As the exchange rate changes, the home currency value of these revenues or expenses changes. If exchange rate changes are more permanent in nature and modify the way a firm does its business, then we say that a firm is facing operating exposure.

21.21. 3.77%

21.23. €0.007171/¥

21.25. C$1.0854 is the ask rate that provides a 0.5 percent spread.

21.27. $4,657,593

21.29. $8,583.75

21.31. $29,192.70

21.33. 4,426,787 million won; yes, the project should be accepted.

21.35. 2.92%; 2.95%; The domestic bond issue will have the lowest cost to the firm.

21.37. $64,062.50; $61,875; Daiwa's offer has the lower interest cost.