

firm borrows more and more, and they eventually overwhelm the tax advantage of debt financing. The optimal capital structure occurs at D^* , the point at which the tax savings from an additional dollar in debt financing is exactly balanced by the increased bankruptcy costs associated with the additional borrowing. This is the essence of the static theory of capital structure.

The bottom part of Figure 16.8 presents the optimal capital structure in terms of the cost of capital. Corresponding to D^* , the optimal debt level, is the optimal debt-equity ratio, D^*/E^* . At this level of debt financing, the lowest possible weighted average cost of capital, $WACC^*$, occurs.

CAPITAL STRUCTURE: SOME MANAGERIAL RECOMMENDATIONS

The static model that we have described is not capable of identifying a precise optimal capital structure, but it does point out two of the more relevant factors: Taxes and financial distress. We can draw some limited conclusions concerning these.

Taxes First of all, the tax benefit from leverage is obviously important only to firms that are in a tax-paying position. Firms with substantial accumulated losses will get little value from the interest tax shield. Furthermore, firms that have substantial tax shields from other sources, such as depreciation, will get less benefit from leverage.

Also, firms all face the same 21 percent federal tax rate beginning in 2018, but other taxes (such as state taxes) create different effective tax rates. The higher the effective tax rate, the greater the incentive to borrow.

Financial Distress Firms with a greater risk of experiencing financial distress will borrow less than firms with a lower risk of financial distress. For example, all other things being equal, the greater the volatility in EBIT, the less a firm should borrow.

In addition, financial distress is more costly for some firms than for others. The costs of financial distress depend primarily on the firm's assets. In particular, financial distress costs will be determined by how easily ownership of those assets can be transferred.

For example, a firm with mostly tangible assets that can be sold without great loss in value will have an incentive to borrow more. For firms that rely heavily on intangibles, such as employee talent or growth opportunities, debt will be less attractive because these assets effectively cannot be sold.

Concept Questions

- 16.6a** Can you describe the trade-off that defines the static theory of capital structure?
- 16.6b** What are the important factors in making capital structure decisions?

16.7 The Pie Again

Although it is comforting to know that the firm might have an optimal capital structure when we take into account real-world matters such as taxes and financial distress costs, it is disquieting to see the elegant original M&M intuition (that is, the no-tax version) fall apart in the face of these matters.

Critics of the M&M theory often say that it fails to hold as soon as we add in real-world issues and that the M&M theory is really just that: A theory that doesn't have much to say

about the real world that we live in. In fact, they would argue that it is the M&M theory that is irrelevant, not capital structure. As we discuss next, taking that view blinds critics to the real value of the M&M theory.

THE EXTENDED PIE MODEL

To illustrate the value of the original M&M intuition, we briefly consider an expanded version of the pie model that we introduced earlier. In the extended pie model, taxes represent just another claim on the cash flows of the firm. Because taxes are reduced as leverage is increased, the value of the government's claim (G) on the firm's cash flows decreases with leverage.

Bankruptcy costs are also a claim on the cash flows of the firm. They come into play as the firm comes close to bankruptcy and has to alter its behavior to attempt to stave off the event itself, and they become large when bankruptcy actually takes place. The value of this claim (B) on the cash flows rises with increases in the debt-equity ratio.

The extended pie model holds that all of these claims can be paid from only one source: The cash flows (CF) of the firm. Algebraically, we must have:

$$\begin{aligned} \text{CF} = & \text{Payments to stockholders} \\ & + \text{Payments to creditors} \\ & + \text{Payments to the government} \\ & + \text{Payments to bankruptcy courts and lawyers} \\ & + \text{Payments to any and all other claimants to the cash flows of the firm} \end{aligned}$$

The extended pie model is illustrated in Figure 16.9. Notice that we have added a few slices for the additional groups. Notice also the change in the relative sizes of the slices as the firm's use of debt financing is increased.

With the list we have developed, we have not even begun to exhaust the potential claims to the firm's cash flows. To give an unusual example, we might say that everyone reading this book has an economic claim on the cash flows of General Motors. After all, if you are injured in an accident, you might sue GM, and, win or lose, GM will expend some of its cash flow in dealing with the matter. For GM, or any other company, there should be a slice of the pie representing potential lawsuits. This is the essence of the M&M intuition

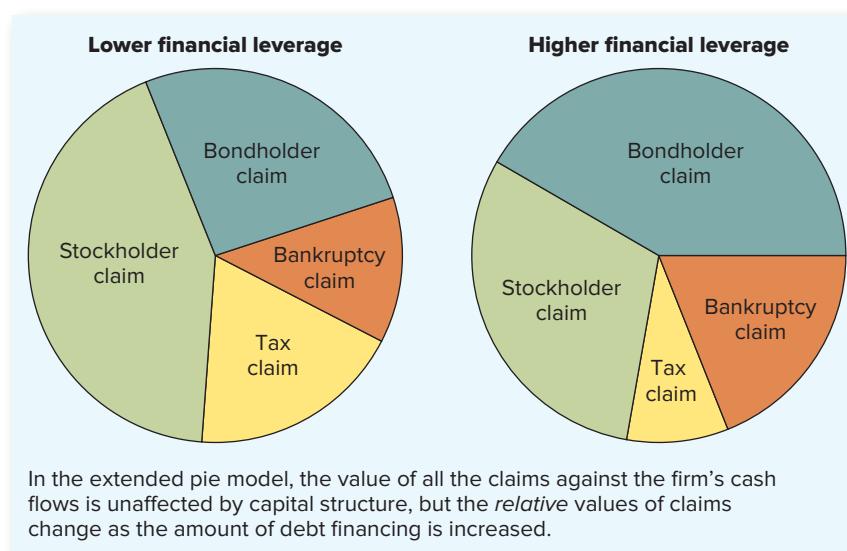


FIGURE 16.9
The Extended Pie Model

and theory: The value of the firm depends on the total cash flow of the firm. The firm's capital structure just cuts that cash flow up into slices without altering the total. What we recognize now is that the stockholders and the bondholders may not be the only ones who can claim a slice.

MARKETED CLAIMS VERSUS NONMARKETED CLAIMS

With our extended pie model, there is an important distinction between claims such as those of stockholders and bondholders, on the one hand, and those of the government and potential litigants in lawsuits on the other. The first set of claims are *marketed claims*, and the second set are *nonmarketed claims*. A key difference is that the marketed claims can be bought and sold in financial markets and the nonmarketed claims cannot be sold in financial markets.

When we speak of the value of the firm, we are generally referring to just the value of the marketed claims, V_M , and not the value of the nonmarketed claims, V_N . If we write V_T for the total value of *all* the claims against a corporation's cash flows, then:

$$\begin{aligned}V_T &= E + D + G + B + \dots \\&= V_M + V_N\end{aligned}$$

The essence of our extended pie model is that this total value, V_T , of all the claims to the firm's cash flows is unaltered by capital structure. However, the value of the marketed claims, V_M , may be affected by changes in the capital structure.

Based on the extended pie model, any increase in V_M must imply an identical decrease in V_N . The optimal capital structure is the one that maximizes the value of the marketed claims or, equivalently, minimizes the value of nonmarketed claims such as taxes and bankruptcy costs.

Concept Questions

- 16.7a** What are some of the claims to a firm's cash flows?
- 16.7b** What is the difference between a marketed claim and a nonmarketed claim?
- 16.7c** What does the extended pie model say about the value of all the claims to a firm's cash flows?

16.8 The Pecking-Order Theory

The static theory we have developed in this chapter has dominated thinking about capital structure for a long time, but it has some shortcomings. Perhaps the most obvious is that many large, financially sophisticated, and highly profitable firms use little debt. This is the opposite of what we would expect. Under the static theory, these are the firms that should use the *most* debt because there is little risk of bankruptcy and the value of the tax shield is substantial. Why do they use so little debt? The pecking-order theory, which we consider next, may be part of the answer.

INTERNAL FINANCING AND THE PECKING ORDER

The pecking-order theory is an alternative to the static theory. A key element in the pecking-order theory is that firms prefer to use internal financing whenever possible.

A simple reason is that selling securities to raise cash can be expensive, so it makes sense to avoid doing so if possible. If a firm is very profitable, it might never need external financing; so it would end up with little or no debt. For example, in late 2017, Alphabet's balance sheet showed assets of \$189.5 billion, of which almost \$100.3 billion were classified as either cash or marketable securities. In fact, Alphabet held so much of its assets in the form of securities that, at one point, it was in danger of being regulated as a mutual fund!

There is a more subtle reason that companies may prefer internal financing. Suppose you are the manager of a firm, and you need to raise external capital to fund a new venture. As an insider, you are privy to a lot of information that isn't known to the public. Based on your knowledge, the firm's future prospects are considerably brighter than outside investors realize. As a result, you think your stock is currently undervalued. Should you issue debt or equity to finance the new venture?

If you think about it, you definitely don't want to issue equity in this case. The reason is that your stock is undervalued, and you don't want to sell it too cheaply. So, you issue debt instead.

Would you ever want to issue equity? Suppose you thought your firm's stock was overvalued. It makes sense to raise money at inflated prices, but a problem crops up. If you try to sell equity, investors will realize that the shares are probably overvalued, and your stock price will take a hit. In other words, if you try to raise money by selling equity, you run the risk of signaling to investors that the price is too high. In fact, in the real world, companies rarely sell new equity, and the market reacts negatively to such sales when they occur.

So, we have a pecking order. Companies will use internal financing first. Then, they will issue debt if necessary. Equity will be sold pretty much as a last resort.

IMPLICATIONS OF THE PECKING ORDER

The pecking-order theory has several significant implications, a couple of which are at odds with our static theory:

1. *No target capital structure:* Under the pecking-order theory, there is no target or optimal debt-equity ratio. Instead, a firm's capital structure is determined by its need for external financing, which dictates the amount of debt the firm will have.
2. *Profitable firms use less debt:* Because profitable firms have greater internal cash flow, they will need less external financing and will therefore have less debt. As we mentioned earlier, this is a pattern that we seem to observe, at least for some companies.
3. *Companies will want financial slack:* To avoid selling new equity, companies will want to stockpile internally generated cash. Such a cash reserve is known as *financial slack*. It gives management the ability to finance projects as they appear and to move quickly if necessary.

Which theory, static or pecking-order, is correct? Financial researchers have not reached a definitive conclusion on this issue, but we can make a few observations. The static theory speaks more to long-run financial goals or strategies. The issues of tax shields and financial distress costs are plainly important in that context. The pecking-order theory is more concerned with the shorter-run, tactical issue of raising external funds to finance investments. So both theories are useful ways of understanding corporate use of debt. For example, it is probably the case that firms have long-run, target capital structures, but it is also probably true that they will deviate from those long-run targets as needed to avoid issuing new equity.

Concept Questions

- 16.8a** Under the pecking-order theory, what is the order in which firms will obtain financing?
- 16.8b** Why might firms prefer not to issue new equity?
- 16.8c** What are some differences in implications of the static and pecking-order theories?

16.9 Observed Capital Structures

No two firms have identical capital structures. Nonetheless, we see some regular elements when we start looking at actual capital structures. We discuss a few of these next.

The most striking thing we observe about capital structures, particularly in the United States, is that most corporations seem to have relatively low debt-equity ratios. In fact, most corporations use much less debt financing than equity financing. To illustrate, Table 16.7 presents median debt ratios and debt-equity ratios for various U.S. industries classified by SIC code (we discussed such codes in Chapter 3).

In Table 16.7, what is most striking is the wide variation across industries, ranging from essentially no debt for drug and computer companies to relatively heavy debt usage in the airline and cable television industries. Notice that these last two industries are the only ones for which more debt is used than equity, and most of the other industries rely far more heavily on equity than debt. This is true even though many of the companies in these industries pay substantial taxes. Table 16.7 makes it clear that corporations have not, in general, issued debt up to the point that tax shelters have been completely used up, and we conclude that there must be limits to the amount of debt corporations can use. Take a look at our nearby *Work the Web* box for more about actual capital structures.

TABLE 16.7

Capital Structures for U.S. Industries

SOURCE: Ibbotson Cost of Capital Yearbook. Chicago: Morningstar, 2010.

Industry	Ratio of Debt to Total Capital*	Ratio of Debt to Equity	Number of Companies	SIC Code	Representative Companies
Electric utilities	48.54%	94.31%	33	491	American Electric Power, Southern Co.
Computer equipment	9.09	10.02	48	357	Apple, Cisco
Paper	27.75	38.40	24	26	Avery Dennison, Weyerhaeuser
Petroleum refining	32.27	47.65	18	29	Chevron, Sunoco
Airlines	63.92	177.19	10	4512	Delta, Southwest
Pay television	63.56	193.88	5	484	Dish Network, TiVo
Motor vehicles	17.77	21.60	25	371	Ford, Winnebago
Fabric apparel	15.86	18.84	14	23	Guess, Nine West
Department stores	27.40	37.73	8	531	J.C. Penney, Macy's
Eating places	23.40	30.54	42	5812	McDonald's, Papa John's
Drugs	7.80	8.46	194	283	Merck, Pfizer
Steel works	19.96	24.95	9	331	Nucor, U.S. Steel

*Debt is the book value of preferred stock and long-term debt, including amounts due in one year. Equity is the market value of outstanding shares. Total capital is the sum of debt and equity. Median values are shown.

WORK THE WEB

When it comes to capital structure, all companies (and industries) are not created equal. To illustrate, we looked up some capital structure information on American Airlines (AAL) and Pfizer (PFE) using the Financials area of www.reuters.com. American Airlines's capital structure looks like this (note that leverage ratios are expressed as percentages on this site):



FINANCIAL STRENGTH			
	Company	industry	sector
Quick Ratio (MRQ)	0.68	0.90	2.07
Current Ratio (MRQ)	0.76	0.97	2.49
LT Debt to Equity (MRQ)	490.66	92.30	65.25
Total Debt to Equity (MRQ)	531.61	143.06	90.49
Interest Coverage (TTM)	8.55	13.73	14.40

For every dollar of equity, American Airlines has long-term debt of \$4.9066 and total debt of \$5.3161. Compare this result to Pfizer:

FINANCIAL STRENGTH			
	Company	industry	sector
Quick Ratio (MRQ)	0.89	2.29	2.41
Current Ratio (MRQ)	1.11	3.21	3.31
LT Debt to Equity (MRQ)	48.08	21.38	21.99
Total Debt to Equity (MRQ)	69.61	30.44	30.99
Interest Coverage (TTM)	23.64	38.25	38.48

For every dollar of equity, Pfizer has only \$.4808 of long-term debt and total debt of \$.6961. When we examine the industry and sector averages, the differences are again apparent. Although the choice of capital structure is a management decision, it is clearly influenced by industry characteristics.

Questions

1. The ratios shown for these companies were based on January 2017 figures. Go to www.reuters.com and find the current long-term debt-to-equity and total debt-to-equity ratios for both American Airlines and Pfizer. How have these ratios changed over this time?
2. Go to www.reuters.com and find the long-term debt-to-equity and total debt-to-equity ratios for Bank of America (BAC), Cisco (CSCO), and Chevron (CVX). Why do you think these three companies use such differing amounts of debt?

Because different industries have different operating characteristics in terms of, for example, EBIT volatility and asset types, there does appear to be some connection between these characteristics and capital structure. Our story involving tax savings, financial distress costs, and potential pecking orders undoubtedly supplies part of the reason; but, to date, there is no fully satisfactory theory that explains these regularities in capital structures.

Concept Questions

- 16.9a** Do U.S. corporations rely heavily on debt financing?
- 16.9b** What regularities do we observe in capital structures?

16.10 A Quick Look at the Bankruptcy Process

As we have discussed, one consequence of using debt is the possibility of financial distress, which can be defined in several ways:

1. *Business failure*: This term is usually used to refer to a situation in which a business has terminated with a loss to creditors; but even an all-equity firm can fail.
2. *Legal bankruptcy*: Firms or creditors bring petitions to a federal court for bankruptcy. **Bankruptcy** is a legal proceeding for liquidating or reorganizing a business.
3. *Technical insolvency*: Technical insolvency occurs when a firm is unable to meet its financial obligations.
4. *Accounting insolvency*: Firms with negative net worth are insolvent on the books. This happens when the total book liabilities exceed the book value of the total assets.

We now very briefly discuss some of the terms and more relevant issues associated with bankruptcy and financial distress.

LIQUIDATION AND REORGANIZATION

Firms that cannot or choose not to make contractually required payments to creditors have two basic options: Liquidation or reorganization. **Liquidation** means termination of the firm as a going concern, and it involves selling off the assets of the firm. The proceeds, net of selling costs, are distributed to creditors in order of established priority. **Reorganization** is the option of keeping the firm a going concern; it often involves issuing new securities to replace old securities. Liquidation or reorganization is the result of a bankruptcy proceeding. Which occurs depends on whether the firm is worth more “dead or alive.”

Bankruptcy Liquidation Chapter 7 of the Federal Bankruptcy Reform Act of 1978 deals with “straight” liquidation. The following sequence of events is typical:

1. A petition is filed in a federal court. Corporations may file a voluntary petition, or involuntary petitions may be filed against the corporation by several of its creditors.
2. A trustee-in-bankruptcy is elected by the creditors to take over the assets of the debtor corporation. The trustee will attempt to liquidate the assets.
3. When the assets are liquidated, after payment of the bankruptcy administration costs, the proceeds are distributed among the creditors.
4. If any proceeds remain, after expenses and payments to creditors, they are distributed to the shareholders.

bankruptcy

A legal proceeding for liquidating or reorganizing a business.

liquidation

Termination of the firm as a going concern.

reorganization

Financial restructuring of a failing firm to attempt to continue operations as a going concern.



The SEC has a good overview of the bankruptcy process in its “Online Publications” section at www.sec.gov.

The distribution of the proceeds of the liquidation occurs according to the following priority list:

1. Administrative expenses associated with the bankruptcy.
2. Other expenses arising after the filing of an involuntary bankruptcy petition but before the appointment of a trustee.
3. Wages, salaries, and commissions.
4. Contributions to employee benefit plans.
5. Consumer claims.
6. Government tax claims.
7. Payment to unsecured creditors.
8. Payment to preferred stockholders.
9. Payment to common stockholders.

This priority list for liquidation is a reflection of the **absolute priority rule (APR)**. The higher a claim is on this list, the more likely it is to be paid. In many of these categories, there are various limitations and qualifications that we omit for the sake of brevity.

Two qualifications to this list are in order. The first concerns secured creditors. Such creditors are entitled to the proceeds from the sale of the security and are outside this ordering. If the secured property is liquidated and provides cash insufficient to cover the amount owed, the secured creditors join with unsecured creditors in dividing the remaining liquidated value. In contrast, if the secured property is liquidated for proceeds greater than the secured claim, the net proceeds are used to pay unsecured creditors and others. The second qualification to the APR is that, in reality, what happens, and who gets what, in the event of bankruptcy are subject to much negotiation; as a result, the APR is frequently not followed.

absolute priority rule (APR)

The rule establishing priority of claims in liquidation.

Bankruptcy Reorganization Corporate reorganization takes place under Chapter 11 of the Federal Bankruptcy Reform Act of 1978. The general objective of a proceeding under Chapter 11 is to plan to restructure the corporation with some provision for repayment of creditors. A typical sequence of events follows:

1. A voluntary petition can be filed by the corporation, or an involuntary petition can be filed by creditors.
2. A federal judge either approves or denies the petition. If the petition is approved, a time for filing proofs of claims is set.
3. In most cases, the corporation (the “debtor in possession”) continues to run the business.
4. The corporation (and, in certain cases, the creditors) submits a reorganization plan.
5. Creditors and shareholders are divided into classes. A class of creditors accepts the plan if a majority of the class agrees to the plan.
6. After its acceptance by creditors, the plan is confirmed by the court.
7. Payments in cash, property, and securities are made to creditors and shareholders. The plan may provide for the issuance of new securities.
8. For some fixed length of time, the firm operates according to the provisions of the reorganization plan.



Get the latest on bankruptcy at www.bankruptcydata.com.

The corporation may wish to allow the old stockholders to retain some participation in the firm. Needless to say, this may involve some protest by the holders of unsecured debt.

So-called prepackaged bankruptcies are a relatively common phenomenon. What happens is that the corporation secures the necessary approval of a bankruptcy plan from a majority of its creditors first, and then it files for bankruptcy. As a result, the company enters bankruptcy and reemerges almost immediately.

For example, one of the largest Chapter 11 prepackaged bankruptcies to date began when business lender CIT Group filed for bankruptcy on November 1, 2009. Under the terms of the agreement, stockholders were wiped out entirely and bondholders' claims were reduced by \$10.5 billion. At the same time, the maturity on the company's debt was extended by three years. An additional debt reduction occurred when \$2.3 billion in "bailout" funds received by the company under the U.S. government's Troubled Asset Relief Program (TARP) were wiped out. Thanks to the prepack, the company moved quickly through the bankruptcy process, emerging from bankruptcy proceedings on December 10, 2009.

In another recent example, on October 24, 2016, Houston-based Key Energy Services filed for a prepack bankruptcy. Under the terms of the plan, the company's debt would be reduced from \$1.2 billion to \$250 million, existing creditors would be granted shares of the company's new stock, and rights would be issued on the company's new stock to repay principal and interest on an outstanding loan. Surprisingly, existing shareholders received a reduced number of shares of new stock, with rights and warrants to buy more. Key Energy Services exited its prepack bankruptcy on December 15, 2016, only 52 days after entering bankruptcy.

In some cases, the bankruptcy procedure is needed to invoke the "cram-down" power of the bankruptcy court. Under certain circumstances, a class of creditors can be forced to accept a bankruptcy plan even if they vote not to approve it—hence the remarkably apt description "cram down."

In 2005, Congress passed the most significant overhaul of U.S. bankruptcy laws in the last 25 years, the Bankruptcy Abuse Prevention and Consumer Protection Act of 2005 (BAPCPA). Most of the changes were aimed at individual debtors, but corporations were also affected. Before BAPCPA, a bankrupt company had the exclusive right to submit reorganization plans to the bankruptcy court. It has been argued that this exclusivity is one reason some companies have remained in bankruptcy for so long. Under the new law, after 18 months, creditors can submit their own plan for the court's consideration. This change is likely to speed up bankruptcies and also lead to more prepacks.

One controversial change made by BAPCPA has to do with so-called key employee retention plans, or KERPs. Strange as it may sound, bankrupt companies routinely give bonus payments to executives, even though the executives may be the same ones who led the company into bankruptcy in the first place. Such bonuses are intended to keep valuable employees from moving to more successful firms, but critics have argued they are often abused. The new law permits KERPs only if the employee in question actually has a job offer from another company.

Recently, Section 363 of the bankruptcy code has been in the news. In a traditional Chapter 11 filing, the bankruptcy plan is described to creditors and shareholders in a prospectus-like disclosure. The plan must then be approved by a vote involving the interested parties. A Section 363 bankruptcy is more like an auction. An initial bidder, known as a *stalking horse*, bids on all or part of the bankrupt company's assets. Other bidders are then invited into the process to determine the highest bid for the company's assets. The main advantage of a Section 363 bankruptcy is speed. Since a traditional bankruptcy requires the approval of interested parties, it is not uncommon for the process to take several years, while a Section 363 bankruptcy is generally much quicker. For example, in the middle of 2009, both General Motors and Chrysler sped through the bankruptcy process in less than 45 days with the help of Section 363 sales.

FINANCIAL MANAGEMENT AND THE BANKRUPTCY PROCESS

It may seem a little odd, but the right to go bankrupt is very valuable. There are several reasons why this is true. First, from an operational standpoint, when a firm files for bankruptcy, there is an immediate “stay” on creditors, usually meaning that payments to creditors will cease, and creditors will have to await the outcome of the bankruptcy process to find out if and how much they will be paid. This stay gives the firm time to evaluate its options, and it prevents what is usually termed a “race to the courthouse steps” by creditors and others.

Beyond this, some bankruptcy filings are actually strategic actions intended to improve a firm’s competitive position, and firms have filed for bankruptcy even though they were not insolvent at the time. Probably the most famous example is Continental Airlines. In 1983, following deregulation of the airline industry, Continental found itself competing with newly established airlines that had much lower labor costs. Continental filed for reorganization under Chapter 11 even though it was not insolvent.

Continental argued that, based on pro forma data, it would become insolvent in the future, and a reorganization was therefore necessary. By filing for bankruptcy, Continental was able to terminate its existing labor agreements, lay off large numbers of workers, and slash wages for the remaining employees. In other words, at least in the eyes of critics, Continental essentially used the bankruptcy process as a vehicle for reducing labor costs. Congress subsequently modified bankruptcy laws to make it more difficult, though not impossible, for companies to abrogate a labor contract through the bankruptcy process. For example, Delta Air Lines filed for bankruptcy in 2005, in part to renegotiate the contracts with its union employees.

Other famous examples of strategic bankruptcies exist. For example, Manville (then known as Johns-Manville) and Dow Corning filed for bankruptcies because of expected future losses resulting from litigation associated with asbestos and silicone breast implants, respectively. Similarly, in the then-largest-ever bankruptcy, Texaco filed in 1987 after Pennzoil was awarded a \$10.3 billion judgment against the company. Texaco later settled for \$3.5 billion and emerged from bankruptcy. As of early 2018, the largest bankruptcies in the United States in terms of assets were the 2008 bankruptcy of Lehman Brothers (with \$691 billion in assets) and the collapse of Washington Mutual (with \$328 billion in assets), also in 2008. However, the 2003 bankruptcy filing of Italian dairy company Parmalat may have topped them both in terms of relative importance. This company, by itself, represented 1.5 percent of the Italian gross national product!

AGREEMENTS TO AVOID BANKRUPTCY

When a firm defaults on an obligation, it can avoid a bankruptcy filing. Because the legal process of bankruptcy can be lengthy and expensive, it is often in everyone’s best interest to devise a “workout” that avoids a bankruptcy filing. Much of the time, creditors can work with the management of a company that has defaulted on a loan contract. Voluntary arrangements to restructure or “reschedule” the company’s debt can be, and often are, made. This may involve *extension*, which postpones the date of payment, or *composition*, which involves a reduced payment.

Concept Questions

16.10a What is the APR?

16.10b What is the difference between liquidation and reorganization?

16.11 Summary and Conclusions

The ideal mixture of debt and equity for a firm—its optimal capital structure—is the one that maximizes the value of the firm and minimizes the overall cost of capital. If we ignore taxes, financial distress costs, and any other imperfections, we find that there is no ideal mixture. Under these circumstances, the firm's capital structure is irrelevant.

If we consider the effect of corporate taxes, we find that capital structure matters a great deal. This conclusion is based on the fact that interest is tax deductible and generates a valuable tax shield. Unfortunately, we also find that the optimal capital structure is 100 percent debt, which is not something we observe in healthy firms.

When we introduce costs associated with bankruptcy, or, more generally, financial distress, we see that these costs reduce the attractiveness of debt financing. We conclude that an optimal capital structure exists when the net tax savings from an additional dollar in interest just equals the increase in expected financial distress costs. This is the essence of the static theory of capital structure.

In this chapter we also considered the pecking-order theory of capital structure as an alternative to the static theory. This theory suggests that firms will use internal financing as much as possible, followed by debt financing if needed. Equity will not be issued if possible. As a result, a firm's capital structure just reflects its historical needs for external financing, so there is no optimal capital structure.

When we examine actual capital structures, we find two regularities. First, firms in the United States typically do not use great amounts of debt, but they pay substantial taxes. This suggests that there is a limit to the use of debt financing to generate tax shields. Second, firms in similar industries tend to have similar capital structures, suggesting that the nature of their assets and operations is an important determinant of capital structure.

CONNECT TO FINANCE



connect[®]

Connect Finance offers you plenty of opportunities to practice mastering these concepts. Log on to connect.mheducation.com to learn more. If you like what you see, ask your professor about using *Connect Finance*!

Can you answer the following *Connect Quiz* questions?

Section 16.1 Maximizing what will maximize shareholder value?

Section 16.3 What is most closely related to a firm's use of debt in its capital structure?

Section 16.5 Give an example of a direct cost of bankruptcy.

Section 16.7 What claims increase when the debt-equity ratio is increased?

CHAPTER REVIEW AND SELF-TEST PROBLEMS

16.1 EBIT and EPS Suppose the BDJ Corporation has decided in favor of a capital restructuring that involves increasing its existing \$80 million in debt to \$125 million. The interest rate on the debt is 9 percent and is not expected to change. The firm currently has 10 million shares outstanding, and the price per share is \$45. If the restructuring is expected to increase the ROE, what is the minimum level for EBIT that BDJ's management must be expecting? Ignore taxes in your answer.

- 16.2 M&M Proposition II (no taxes)** The Habitat Corporation has a WACC of 16 percent. Its cost of debt is 13 percent. If Habitat's debt-equity ratio is 2, what is its cost of equity capital? Ignore taxes in your answer.
- 16.3 M&M Proposition I (with corporate taxes)** Gypco expects an EBIT of \$10,000 every year forever. Gypco can borrow at 7 percent. Suppose Gypco currently has no debt, and its cost of equity is 17 percent. If the corporate tax rate is 21 percent, what is the value of the firm? What will the value be if Gypco borrows \$15,000 and uses the proceeds to repurchase stock?

ANSWERS TO CHAPTER REVIEW AND SELF-TEST PROBLEMS

- 16.1** To answer, we can calculate the break-even EBIT. At any EBIT above this, the increased financial leverage will increase EPS. Under the old capital structure, the interest bill is $\$80 \text{ million} \times .09 = \$7,200,000$. There are 10 million shares of stock; so, ignoring taxes, EPS is $(\text{EBIT} - \$7.2 \text{ million})/10 \text{ million}$.

Under the new capital structure, the interest expense will be $\$125 \text{ million} \times .09 = \11.25 million . Furthermore, the debt rises by \$45 million. This amount is sufficient to repurchase $\$45 \text{ million}/\$45 = 1 \text{ million}$ shares of stock, leaving 9 million outstanding. EPS is thus $(\text{EBIT} - \$11.25 \text{ million})/9 \text{ million}$.

Now that we know how to calculate EPS under both scenarios, we set the two calculations equal to each other and solve for the break-even EBIT:

$$\begin{aligned} (\text{EBIT} - \$7.2 \text{ million})/10 \text{ million} &= (\text{EBIT} - \$11.25 \text{ million})/9 \text{ million} \\ \text{EBIT} - \$7.2 \text{ million} &= 1.11 \times (\text{EBIT} - \$11.25 \text{ million}) \\ \text{EBIT} &= \$47,700,000 \end{aligned}$$

Verify that, in either case, EPS is \$4.05 when EBIT is \$47.7 million.

- 16.2** According to M&M Proposition II (no taxes), the cost of equity is:

$$\begin{aligned} R_E &= R_A + (R_A - R_D) \times (D/E) \\ &= .16 + (.16 - .13) \times 2 \\ &= .22, \text{ or } 22\% \end{aligned}$$

- 16.3** With no debt, Gypco's WACC is 17 percent. This is also the unlevered cost of capital. The aftertax cash flow is $\$10,000 \times (1 - .21) = \$7,900$, so the value is just $V_U = \$7,900/.17 = \$46,471$.

After the debt issue, Gypco will be worth the original \$46,471 plus the present value of the tax shield. According to M&M Proposition I with taxes, the present value of the tax shield is $T_C \times D$, or $.21 \times \$15,000 = \$3,150$; so the firm is worth $\$46,471 + 3,150 = \$49,621$.

CONCEPTS REVIEW AND CRITICAL THINKING QUESTIONS

- Business Risk versus Financial Risk [LO1]** Explain what is meant by *business risk* and *financial risk*. Suppose Firm A has greater business risk than Firm B. Is it true that Firm A also has a higher cost of equity capital? Explain.
- M&M Propositions [LO1]** How would you answer in the following debate?
 Q: Isn't it true that the riskiness of a firm's equity will rise if the firm increases its use of debt financing?
 A: Yes, that's the essence of M&M Proposition II.

Q: And isn't it true that, as a firm increases its use of borrowing, the likelihood of default increases, thereby increasing the risk of the firm's debt?

A: Yes.

Q: In other words, increased borrowing increases the risk of the equity *and* the debt?

A: That's right.

Q: Well, given that the firm uses only debt and equity financing, and given that the risks of both are increased by increased borrowing, does it not follow that increasing debt increases the overall risk of the firm and therefore decreases the value of the firm?

A: ?

3. **Optimal Capital Structure [LO1]** Is there an easily identifiable debt-equity ratio that will maximize the value of a firm? Why or why not?
4. **Observed Capital Structures [LO1]** Refer to the observed capital structures given in Table 16.7 of the text. What do you notice about the types of industries with respect to their average debt-equity ratios? Are certain types of industries more likely to be highly leveraged than others? What are some possible reasons for this observed segmentation? Do the operating results and tax history of the firms play a role? How about their future earnings prospects? Explain.
5. **Financial Leverage [LO1]** Why is the use of debt financing referred to as financial "leverage"?
6. **Interest Deductibility and Financial Ratios [LO1]** Take a look back at the times interest earned (TIE) ratio we discussed in Chapter 3. For interest paid to be fully deductible by a company after the Tax Cuts and Jobs Act of 2017, what must be true about this ratio? Assume the company has no interest income.
7. **Bankruptcy and Corporate Ethics [LO3]** As mentioned in the text, some firms have filed for bankruptcy because of actual or likely litigation-related losses. Is this a proper use of the bankruptcy process?
8. **Bankruptcy and Corporate Ethics [LO3]** Firms sometimes use the threat of a bankruptcy filing to force creditors to renegotiate terms. Critics argue that in such cases, the firm is using bankruptcy laws "as a sword rather than a shield." Is this an ethical tactic?
9. **Bankruptcy and Corporate Ethics [LO3]** As mentioned in the text, Continental Airlines filed for bankruptcy, at least in part, as a means of reducing labor costs. Whether this move was ethical, or proper, was hotly debated. Give both sides of the argument.
10. **Capital Structure Goal [LO1]** What is the basic goal of financial management with regard to capital structure?

QUESTIONS AND PROBLEMS



1. **EBIT and Leverage [LO1]** Ghost, Inc., has no debt outstanding and a total market value of \$185,000. Earnings before interest and taxes, EBIT, are projected to be \$29,000 if economic conditions are normal. If there is strong expansion in the economy, then EBIT will be 30 percent higher. If there is a recession, then EBIT will be 40 percent lower. The company is considering a \$65,000 debt issue with an interest rate of 7 percent. The proceeds will be used to repurchase shares of stock. There are currently 7,400 shares outstanding. Ignore taxes for this problem.
 - a. Calculate earnings per share (EPS) under each of the three economic scenarios before any debt is issued. Also calculate the percentage changes in EPS when the economy expands or enters a recession.

- b. Repeat part (a) assuming that the company goes through with recapitalization. What do you observe?
2. **EBIT, Taxes, and Leverage [LO2]** Repeat parts (a) and (b) in Problem 1 assuming the company has a tax rate of 21 percent, a market-to-book ratio of 1.0, and the stock price remains constant.
3. **ROE and Leverage [LO1, 2]** Suppose the company in Problem 1 has a market-to-book ratio of 1.0 and the stock price remains constant.
- Calculate return on equity (ROE) under each of the three economic scenarios before any debt is issued. Also calculate the percentage changes in ROE for economic expansion and recession, assuming no taxes.
 - Repeat part (a) assuming the firm goes through with the proposed recapitalization.
 - Repeat parts (a) and (b) of this problem assuming the firm has a tax rate of 21 percent.
4. **Break-Even EBIT [LO1]** Round Hammer is comparing two different capital structures: An all-equity plan (Plan I) and a levered plan (Plan II). Under Plan I, the company would have 180,000 shares of stock outstanding. Under Plan II, there would be 130,000 shares of stock outstanding and \$1.925 million in debt outstanding. The interest rate on the debt is 8 percent, and there are no taxes.
- If EBIT is \$400,000, which plan will result in the higher EPS?
 - If EBIT is \$600,000, which plan will result in the higher EPS?
 - What is the break-even EBIT?
5. **M&M and Stock Value [LO1]** In Problem 4, use M&M Proposition I to find the price per share of equity under each of the two proposed plans. What is the value of the firm?
6. **Break-Even EBIT and Leverage [LO1, 2]** Bellwood Corp. is comparing two different capital structures. Plan I would result in 12,700 shares of stock and \$109,250 in debt. Plan II would result in 9,800 shares of stock and \$247,000 in debt. The interest rate on the debt is 10 percent.
- Ignoring taxes, compare both of these plans to an all-equity plan assuming that EBIT will be \$79,000. The all-equity plan would result in 15,000 shares of stock outstanding. Which of the three plans has the highest EPS? The lowest?
 - In part (a), what are the break-even levels of EBIT for each plan as compared to that for an all-equity plan? Is one higher than the other? Why?
 - Ignoring taxes, when will EPS be identical for Plans I and II?
 - Repeat parts (a), (b), and (c) assuming that the corporate tax rate is 21 percent. Are the break-even levels of EBIT different from before? Why or why not?
7. **Leverage and Stock Value [LO1]** Ignoring taxes in Problem 6, what is the price per share of equity under Plan I? Plan II? What principle is illustrated by your answers?
8. **Homemade Leverage [LO1]** FCOJ, Inc., a prominent consumer products firm, is debating whether to convert its all-equity capital structure to one that is 30 percent debt. Currently, there are 5,800 shares outstanding, and the price per share is \$57. EBIT is expected to remain at \$32,000 per year forever. The interest rate on new debt is 8 percent, and there are no taxes.
- Allison, a shareholder of the firm, owns 100 shares of stock. What is her cash flow under the current capital structure, assuming the firm has a dividend payout rate of 100 percent?
 - What will Allison's cash flow be under the proposed capital structure of the firm? Assume she keeps all 100 of her shares.

- c. Suppose the company does convert, but Allison prefers the current all-equity capital structure. Show how she could unlever her shares of stock to re-create the original capital structure.
 - d. Using your answer to part (c), explain why the company's choice of capital structure is irrelevant.
9. **Homemade Leverage and WACC [LO1]** ABC Co. and XYZ Co. are identical firms in all respects except for their capital structure. ABC is all-equity financed with \$720,000 in stock. XYZ uses both stock and perpetual debt; its stock is worth \$360,000 and the interest rate on its debt is 7 percent. Both firms expect EBIT to be \$73,000. Ignore taxes.
- a. Rico owns \$43,500 worth of XYZ's stock. What rate of return is he expecting?
 - b. Show how Rico could generate exactly the same cash flows and rate of return by investing in ABC and using homemade leverage.
 - c. What is the cost of equity for ABC? What is it for XYZ?
 - d. What is the WACC for ABC? For XYZ? What principle have you illustrated?
10. **M&M [LO1]** Thrice Corp. uses no debt. The weighted average cost of capital is 8.4 percent. If the current market value of the equity is \$16.3 million and there are no taxes, what is EBIT?
11. **M&M and Taxes [LO2]** In Problem 10, suppose the corporate tax rate is 22 percent. What is EBIT in this case? What is the WACC? Explain.
12. **Calculating WACC [LO1]** Blitz Industries has a debt-equity ratio of 1.25. Its WACC is 8.3 percent, and its cost of debt is 5.1 percent. The corporate tax rate is 21 percent.
 - a. What is the company's cost of equity capital?
 - b. What is the company's unlevered cost of equity capital?
 - c. What would the cost of equity be if the debt-equity ratio were 2? What if it were 1? What if it were zero?
13. **Calculating WACC [LO1]** Citee Corp. has no debt but can borrow at 6.1 percent. The firm's WACC is currently 9.4 percent, and the tax rate is 21 percent.
 - a. What is the company's cost of equity?
 - b. If the firm converts to 25 percent debt, what will its cost of equity be?
 - c. If the firm converts to 50 percent debt, what will its cost of equity be?
 - d. What is the company's WACC in part (b)? In part (c)?
14. **M&M and Taxes [LO2]** Meyer & Co. expects its EBIT to be \$97,000 every year forever. The firm can borrow at 8 percent. The company currently has no debt, and its cost of equity is 13 percent. If the tax rate is 24 percent, what is the value of the firm? What will the value be if the company borrows \$195,000 and uses the proceeds to repurchase shares?
15. **M&M and Taxes [LO2]** In Problem 14, what is the cost of equity after recapitalization? What is the WACC? What are the implications for the firm's capital structure decision?
16. **M&M [LO2]** Tool Manufacturing has an expected EBIT of \$51,000 in perpetuity and a tax rate of 21 percent. The firm has \$126,000 in outstanding debt at an interest rate of 5.35 percent, and its unlevered cost of capital is 9.6 percent. What is the value of the firm according to M&M Proposition I with taxes? Should the company change its debt-equity ratio if the goal is to maximize the value of the firm? Explain.

INTERMEDIATE

(Questions 16–18)

- 17. Firm Value [LO2]** Change Corporation expects an EBIT of \$31,200 every year forever. The company currently has no debt, and its cost of equity is 11 percent.
- What is the current value of the company?
 - Suppose the company can borrow at 6 percent. If the corporate tax rate is 22 percent, what will the value of the firm be if the company takes on debt equal to 50 percent of its unlevered value? What if it takes on debt equal to 100 percent of its unlevered value?
 - What will the value of the firm be if the company takes on debt equal to 50 percent of its levered value? What if the company takes on debt equal to 100 percent of its levered value?
- 18. Homemade Leverage [LO1]** The Day Company and the Knight Company are identical in every respect except that Day is not levered. Financial information for the two firms appears in the following table. All earnings streams are perpetuities, and neither firm pays taxes. Both firms distribute all earnings available to common stockholders immediately.

	Day	Knight
Projected operating income	\$ 375,000	\$ 375,000
Year-end interest on debt	—	\$ 54,000
Market value of stock	\$2,300,000	\$1,650,000
Market value of debt	—	\$ 900,000

- An investor who can borrow at 6 percent per year wishes to purchase 5 percent of Knight's equity. Can he increase his dollar return by purchasing 5 percent of Day's equity if he borrows so that the initial net costs of the strategies are the same?
 - Given the two investment strategies in (a), which will investors choose? When will this process cease?
- 19. Weighted Average Cost of Capital [LO1]** In a world of corporate taxes only, show that the WACC can be written as $\text{WACC} = R_u \times [1 - T_c(D/V)]$.
- 20. Cost of Equity and Leverage [LO1]** Assuming a world of corporate taxes only, show that the cost of equity, R_E , is as given in the chapter by M&M Proposition II with corporate taxes.
- 21. Business and Financial Risk [LO1]** Assume a firm's debt is risk-free, so that the cost of debt equals the risk-free rate, R_f . Define β_A as the firm's *asset* beta—that is, the systematic risk of the firm's assets. Define β_E to be the beta of the firm's equity. Use the capital asset pricing model (CAPM) along with M&M Proposition II to show that $\beta_E = \beta_A \times (1 + D/E)$, where D/E is the debt-equity ratio. Assume the tax rate is zero.
- 22. Stockholder Risk [LO1]** Suppose a firm's business operations are such that they mirror movements in the economy as a whole very closely; that is, the firm's asset beta is 1.0. Use the result of Problem 21 to find the equity beta for this firm for debt-equity ratios of 0, 1, 5, and 20. What does this tell you about the relationship between capital structure and shareholder risk? How is the shareholders' required return on equity affected? Explain.

CHALLENGE
(Questions 19–22)

EXCEL MASTER IT! PROBLEM



The TL Corporation currently has no debt outstanding. Josh Culberson, the CFO, is considering restructuring the company by issuing debt and using the proceeds to repurchase outstanding equity. The company's assets are worth \$40 million, the stock price is \$25 per share, and there are 1,600,000 shares outstanding. In the expected state of the economy, EBIT is predicted to be \$3 million. If there is a recession, EBIT would fall to \$1.8 million, and in an expansion, EBIT would increase to \$4.3 million. If the company issues debt, it will issue a combination of short-term debt and long-term debt. The ratio of short-term debt to long-term debt will be .20. The short-term debt will have an interest rate of 3 percent and the long-term debt will have an interest rate of 8 percent.

- a. On the next worksheet, fill in the values in each table. For the debt-equity ratio, create a spinner that changes the debt-equity ratio. The resulting debt-equity ratio should range from 0 to 10 at increments of .1.
- b. Graph the EBIT and EPS for the TL Corporation on the same graph using a scatter plot.
- c. What is the break-even EBIT between the current capital structure and the new capital structure?
- d. To illustrate the new capital structure, you would like to create a pie chart. Another pie chart that is available is the pie in pie chart. Using the pie in pie chart, graph the equity and total debt in the main pie chart and the short-term debt and long-term debt in the secondary pie chart. Note, if you right-click on a data series in the chart and select Format Data Series, the Series Options will permit you to display the series by a customized choice. In the customization, you can select which data series you want displayed in the primary pie chart and the secondary pie chart.

MINICASE

Stephenson Real Estate Recapitalization

Stephenson Real Estate Company was founded 25 years ago by the current CEO, Robert Stephenson. The company purchases real estate, including land and buildings, and rents the property to tenants. The company has shown a profit every year for the past 18 years, and the shareholders are satisfied with the company's management. Prior to founding Stephenson Real Estate, Robert was the founder and CEO of a failed alpaca farming operation. The resulting bankruptcy made him extremely averse to debt financing. As a result, the company is entirely equity financed, with 8 million shares of common stock outstanding. The stock currently trades at \$37.80 per share.

Stephenson is evaluating a plan to purchase a huge tract of land in the southeastern United States for \$85 million. The land will subsequently be leased to tenant farmers. This purchase is expected to increase Stephenson's annual pretax earnings by \$14.125 million in perpetuity. Jennifer Weyand, the company's new CFO, has been put in charge of the project. Jennifer has determined that the company's current cost of capital is 10.2 percent. She feels that the company would be more valuable

if it included debt in its capital structure, so she is evaluating whether the company should issue debt to entirely finance the project. Based on some conversations with investment banks, she thinks that the company can issue bonds at par value with a 6 percent coupon rate. From her analysis, she also believes that a capital structure in the range of 70 percent equity/30 percent debt would be optimal. If the company goes beyond 30 percent debt, its bonds would carry a lower rating and a much higher coupon because the possibility of financial distress and the associated costs would rise sharply. Stephenson has a 23 percent corporate tax rate (state and federal).

QUESTIONS

1. If Stephenson wishes to maximize its total market value, would you recommend that it issue debt or equity to finance the land purchase? Explain.
2. Construct Stephenson's market value balance sheet before it announces the purchase.

3. Suppose Stephenson decides to issue equity to finance the purchase.
 - a. What is the net present value of the project?
 - b. Construct Stephenson's market value balance sheet after it announces that the firm will finance the purchase using equity. What would be the new price per share of the firm's stock? How many shares will Stephenson need to issue to finance the purchase?
 - c. Construct Stephenson's market value balance sheet after the equity issue but before the purchase has been made. How many shares of common stock does Stephenson have outstanding? What is the price per share of the firm's stock?
 - d. Construct Stephenson's market value balance sheet after the purchase has been made.
4. Suppose Stephenson decides to issue debt to finance the purchase.
 - a. What will the market value of the Stephenson Real Estate Company be if the purchase is financed with debt?
 - b. Construct Stephenson's market value balance sheet after both the debt issue and the land purchase. What is the price per share of the firm's stock?
 5. Which method of financing maximizes the per-share stock price of Stephenson's equity?

ON JANUARY 26, 2017, cable TV giant Comcast announced a broad plan to reward stockholders for the recent success of the firm's business. Under the plan, Comcast would (1) boost its annual dividend by 15 percent, from \$1.10 per share to \$1.26 per share; (2) undertake a two-for-one stock split, meaning each share of common stock would be replaced with two new shares; and (3) repurchase about \$5 billion of Comcast's common stock during the next year. Investors cheered, bidding up the stock price by about 3 percent on the day of the announcement, on a day when the stock market as a whole fell. Why were investors so pleased? To find out, this chapter explores these actions and their implications for shareholders.

Learning Objectives

After studying this chapter, you should be able to:

- | | |
|--|---|
| L01 Define dividend types and how dividends are paid. | L03 Describe the difference between cash and stock dividends. |
| L02 Explain the issues surrounding dividend policy decisions. | L04 Explain why share repurchases are an alternative to dividends. |

©by_adri/StockPhoto/GettyImages

For updates on the latest happenings in finance, visit fundamentals-of-corporate-finance.blogspot.com.

Dividend policy is an important subject in corporate finance, and dividends are a major cash outlay for many corporations. For example, S&P 500 companies paid about \$397 billion in dividends in 2016, an increase from the \$383 billion paid in 2015, and a record for dividends paid. In fact, dividends globally were \$1.024 trillion. ExxonMobil and Apple were the biggest payers. How big? ExxonMobil paid out about \$12.5 billion in dividends during 2016 and Apple paid out about \$12 billion. In contrast, about 16 percent of the companies in the S&P 500 paid no dividend at all.

At first glance, it may seem obvious that a firm would always want to give as much as possible back to its shareholders by paying dividends. It might seem equally obvious that a firm could always invest the money for its shareholders instead of paying it out. The heart of the dividend policy question is this: Should the firm pay out money to its shareholders, or should the firm take that money and invest it for its shareholders?

In this chapter, we will cover a variety of topics related to dividends and corporate payout policies. We first discuss the various types of cash dividends and how they are paid. We ask whether dividend policy matters, and we consider arguments in favor of both high and low dividend payouts. Next, we examine stock repurchases, which have become an important alternative to cash dividends. We then bring together several decades

of research on dividends and corporate payouts to describe the key trade-offs involved in establishing a payout policy. We conclude the chapter by discussing stock splits and stock dividends.

Cash Dividends and Dividend Payment

The term **dividend** usually refers to cash paid out of earnings. If a payment is made from sources other than current or accumulated retained earnings, the term **distribution**, rather than *dividend*, is used. It is acceptable to refer to a distribution from earnings as a dividend and a distribution from capital as a liquidating dividend. More generally, any direct payment by the corporation to the shareholders may be considered a dividend or a part of dividend policy.

Dividends come in several different forms. The basic types of cash dividends are these:

1. Regular cash dividends.
2. Extra dividends.
3. Special dividends.
4. Liquidating dividends.

Later in the chapter, we discuss dividends paid in stock instead of cash. We also consider another alternative to cash dividends: Stock repurchase.

CASH DIVIDENDS

The most common type of dividend is a cash dividend. Commonly, public companies pay **regular cash dividends** four times per year. As the name suggests, these are cash payments made directly to shareholders, and they are made in the regular course of business. In other words, management sees nothing unusual about the dividend and no reason why it won't be continued.

Sometimes firms will pay a regular cash dividend and an *extra cash dividend*. By calling part of the payment "extra," management is indicating that the "extra" part may or may not be repeated in the future. A *special dividend* is similar, but the name usually indicates that this dividend is viewed as a truly unusual or one-time event and won't be repeated. For example, in December 2004, Microsoft paid a special dividend of \$3 per share. The total payout of \$32 billion was the largest one-time corporate dividend in history. Founder Bill Gates received about \$3 billion, which he pledged to donate to charity. To give you another idea of the size of the special dividend, consider that in December, when the dividend was sent to investors, personal income in the United States rose 3.7 percent. Without the dividend, personal income rose only .3 percent, so the dividend payment accounted for about 3 percent of all personal income in the United States for the month! Finally, the payment of a *liquidating dividend* usually means that some or all of the business has been liquidated—that is, sold off.

However it is labeled, a cash dividend payment reduces corporate cash and retained earnings, except in the case of a liquidating dividend (which may reduce paid-in capital).

17.1

dividend

A payment made out of a firm's earnings to its owners, in the form of either cash or stock.

distribution

A payment made by a firm to its owners from sources other than current or accumulated retained earnings.

regular cash dividend

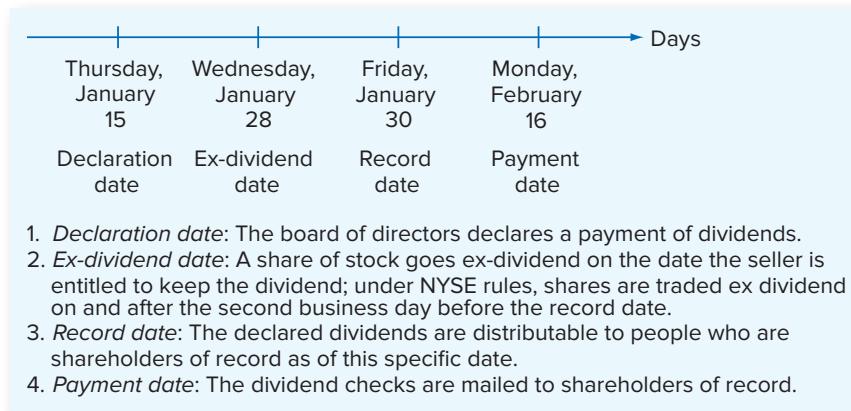
A cash payment made by a firm to its owners in the normal course of business, usually paid four times per year.



For a list of companies that are paying dividends today, go to www.thestreet.com/dividends/.

STANDARD METHOD OF CASH DIVIDEND PAYMENT

The decision to pay a dividend rests in the hands of the board of directors of the corporation. When a dividend has been declared, it becomes a debt of the firm and cannot easily be rescinded. Sometime after it has been declared, a dividend is distributed to all shareholders as of some specific date.

FIGURE 17.1**Example of Procedure for Dividend Payment**

Commonly, the amount of the cash dividend is expressed in terms of dollars per share (*dividends per share*). As we have seen in other chapters, it is also expressed as a percentage of the market price (the *dividend yield*) or as a percentage of net income or earnings per share (the *dividend payout*).

DIVIDEND PAYMENT: A CHRONOLOGY

The mechanics of a cash dividend payment can be illustrated by the example in Figure 17.1 and the following description:

declaration date

The date on which the board of directors passes a resolution to pay a dividend.

ex-dividend date

The date two business days before the date of record, establishing those individuals entitled to a dividend.

date of record

The date by which a holder must be on record to be designated to receive a dividend.

date of payment

The date on which the dividend checks are mailed.

1. **Declaration date:** On January 15, the board of directors passes a resolution to pay a dividend of \$1 per share on February 16 to all holders of record as of January 30.

2. **Ex-dividend date:** To make sure that dividend checks go to the right people, brokerage firms and stock exchanges establish an ex-dividend date. This date is two business days before the date of record (discussed next). If you buy the stock before this date, you are entitled to the dividend. If you buy on this date or after, the previous owner will get the dividend.

In Figure 17.1, Wednesday, January 28, is the ex-dividend date. Before this date, the stock is said to trade “with dividend” or “cum dividend.” Afterward, the stock trades “ex dividend.”

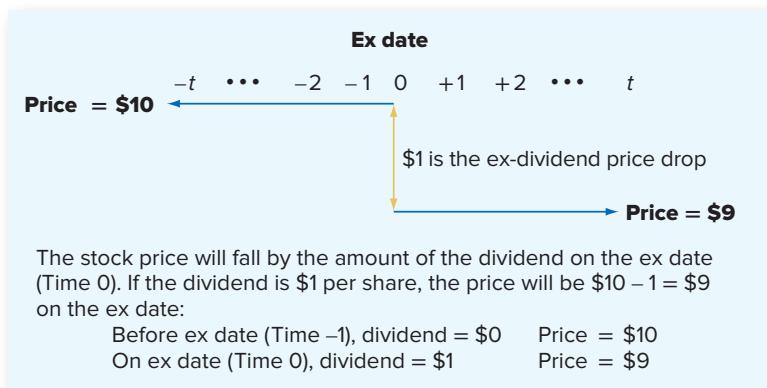
The ex-dividend date convention removes any ambiguity about who is entitled to the dividend. Because the dividend is valuable, the stock price will be affected when the stock goes “ex.” We examine this effect in a moment.

3. **Date of record:** Based on its records, the corporation prepares a list on January 30 of all individuals believed to be stockholders. These are the *holders of record*, and January 30 is the date of record (or record date). The word *believed* is important here. If you buy the stock just before this date, the corporation’s records may not reflect that fact because of mailing or other delays. Without some modification, some of the dividend checks will get mailed to the wrong people. This is the reason for the ex-dividend date convention.

4. **Date of payment:** The dividend checks are mailed on February 16.

MORE ABOUT THE EX-DIVIDEND DATE

The ex-dividend date is important and is a common source of confusion. We examine what happens to the stock when it goes ex, meaning that the ex-dividend date arrives.

**FIGURE 17.2**

Price Behavior around the Ex-Dividend Date for a \$1 Cash Dividend

To illustrate, suppose we have a stock that sells for \$10 per share. The board of directors declares a dividend of \$1 per share, and the record date is set to be Tuesday, June 12. Based on our previous discussion, we know that the ex date will be two business (not calendar) days earlier, on Friday, June 8.

If you buy the stock on Thursday, June 7, just as the market closes, you'll get the \$1 dividend because the stock is trading cum dividend. If you wait and buy it just as the market opens on Friday, you won't get the \$1 dividend. What happens to the value of the stock overnight?

If you think about it, you will see that the stock is worth about \$1 less on Friday morning, so its price will drop by this amount between close of business on Thursday and the Friday opening. In general, we expect that the value of a share of stock will go down by about the dividend amount when the stock goes ex dividend. The key word here is *about*. Because dividends are taxed, the actual price drop might be closer to some measure of the aftertax value of the dividend. Determining this value is complicated because of the different tax rates and tax rules that apply for different buyers.

The series of events described here is illustrated in Figure 17.2.

“Ex” Marks the Day

EXAMPLE 17.1

The board of directors of Divided Airlines has declared a dividend of \$2.50 per share payable on Tuesday, May 30, to shareholders of record as of Tuesday, May 9. Cal Icon buys 100 shares of Divided on Tuesday, May 2, for \$150 per share. What is the ex date? Describe the events that will occur with regard to the cash dividend and the stock price.

The ex date is two business days before the date of record, Tuesday, May 9; so the stock will go ex on Friday, May 5. Cal buys the stock on Tuesday, May 2, so Cal purchases the stock cum dividend. In other words, Cal will get $\$2.50 \times 100 = \250 in dividends. The check will be mailed on Tuesday, May 30. Just before the stock does go ex on Friday, its value will drop overnight by about \$2.50 per share.

As an example of the price drop on the ex-dividend date, we examine the large dividend paid by Warrior Met Coal, operator of coal mines in Alabama, in November 2017. The dividend was \$11.21 per share at a time when the stock price was around \$30, so the dividend was about 40 percent of the total stock price, a truly special dividend. The stock went ex dividend on November 24, 2017. The stock price chart here shows the change in Warrior stock four days prior to the ex-dividend date and on the ex-dividend date.



The stock closed at \$29.90 on November 22 (November 23 was a holiday) and opened at \$18.65 on November 24—a drop of \$11.25. With a 20 percent tax rate on dividends, we would have expected a drop of about \$9, so the actual price dropped more than we would have expected. We discuss dividends and taxes in more detail in a subsequent section.

Concept Questions

- 17.1a** What are the different types of cash dividends?
- 17.1b** What are the mechanics of the cash dividend payment?
- 17.1c** How should the price of a stock change when it goes ex dividend?

17.2 Does Dividend Policy Matter?

To decide whether or not dividend policy matters, we first have to define what we mean by dividend *policy*. All other things being the same, of course dividends matter. Dividends are paid in cash, and cash is something that everybody likes. The question we will be discussing here is whether the firm should pay out cash now or invest the cash and pay it out later. Dividend policy is the time pattern of dividend payout. In particular, should the firm pay out a large percentage of its earnings now or a small (or even zero) percentage? This is the dividend policy question.

AN ILLUSTRATION OF THE IRRELEVANCE OF DIVIDEND POLICY

A powerful argument can be made that dividend policy does not matter. We illustrate this by considering the simple case of Wharton Corporation. Wharton is an all-equity firm that has existed for 10 years. The current financial managers plan to dissolve the firm in two years. The total cash flows the firm will generate, including the proceeds from liquidation, will be \$10,000 in each of the next two years.

Current Policy: Dividends Set Equal to Cash Flow At the present time, dividends at each date are set equal to the cash flow of \$10,000. There are 100 shares outstanding, so the dividend per share is \$100. In Chapter 6, we showed that the value of the

stock is equal to the present value of the future dividends. Assuming a 10 percent required return, the value of a share of stock today, P_0 , is:

$$\begin{aligned}P_0 &= \frac{D_1}{(1+R)^1} + \frac{D_2}{(1+R)^2} \\&= \frac{\$100}{1.10} + \frac{\$100}{1.10^2} = \$173.55\end{aligned}$$

The firm as a whole is worth $100 \times \$173.55 = \$17,355$.

Several members of the board of Wharton have expressed dissatisfaction with the current dividend policy and have asked you to analyze an alternative policy.

Alternative Policy: Initial Dividend Greater than Cash Flow Another possible policy is for the firm to pay a dividend of \$110 per share on the first date (Date 1), which is, of course, a total dividend of \$11,000. Because the cash flow is only \$10,000, an extra \$1,000 must somehow be raised. One way to do this is to issue \$1,000 worth of bonds or stock at Date 1. Assume that stock is issued. The new stockholders will desire enough cash flow at Date 2 so that they earn the required 10 percent return on their Date 1 investment.¹

What is the value of the firm with this new dividend policy? The new stockholders invest \$1,000. They require a 10 percent return, so they will demand $\$1,000 \times 1.10 = \$1,100$ of the Date 2 cash flow, leaving only \$8,900 to the old stockholders. The dividends to the old stockholders will be as follows:

	Date 1	Date 2
Aggregate dividends to old stockholders	\$11,000	\$8,900
Dividends per share	110	89

The present value of the dividends per share is:

$$P_0 = \frac{\$110}{1.10} + \frac{89}{1.10^2} = \$173.55$$

This is the same value we had before.

The value of the stock is unaffected by this switch in dividend policy even though we have to sell some new stock to finance the new dividend. In fact, no matter what pattern of dividend payout the firm chooses, the value of the stock will always be the same in this example. In other words, for the Wharton Corporation, dividend policy makes no difference. The reason is simple: Any increase in a dividend at some point in time is exactly offset by a decrease at some other time; so the net effect, once we account for time value, is zero.

HOMEMADE DIVIDENDS

There is an alternative and perhaps more intuitively appealing explanation of why dividend policy doesn't matter in our example. Suppose individual Investor X prefers dividends per share of \$100 at both Dates 1 and 2. Would she be disappointed if informed that the firm's management was adopting the alternative dividend policy (dividends of \$110 and \$89 on the two dates, respectively)? Not necessarily: She could easily reinvest the \$10 of unneeded

¹The same results would occur after an issue of bonds, though the arguments would be less easily presented.

funds received on Date 1 by buying more Wharton stock. At 10 percent, this investment would grow to \$11 by Date 2. Investor X would receive her desired net cash flow of $\$110 - \$100 = \$10$ at Date 1 and $\$89 + \$11 = \$100$ at Date 2.

Conversely, imagine that Investor Z, preferring \$110 of cash flow at Date 1 and \$89 of cash flow at Date 2, finds that management will pay dividends of \$100 at both Dates 1 and 2. This investor can sell \$10 worth of stock to boost his total cash at Date 1 to \$110. Because this investment returns 10 percent, Investor Z gives up \$11 at Date 2 ($= \10×1.1), leaving him with $\$100 - \$11 = \$89$.

Our two investors are able to transform the corporation's dividend policy into a different policy by buying or selling on their own. The result is that investors are able to create a **homemade dividend policy**. This means that dissatisfied stockholders can alter the firm's dividend policy to suit themselves. As a result, there is no particular advantage to any one dividend policy the firm might choose.

Many corporations actually assist their stockholders in creating homemade dividend policies by offering *automatic dividend reinvestment plans* (ADRs or DRIPs). McDonald's, Walmart, and Procter & Gamble, for example, have set up such plans. As the name suggests, with such a plan, stockholders have the option of automatically reinvesting some or all of their cash dividend in shares of stock. In some cases, they actually receive a discount on the stock, which makes such plans very attractive.

homemade dividend policy

The tailored dividend policy created by individual investors who undo corporate dividend policy by reinvesting dividends or selling shares of stock.



For more information on DRIPs, check out the Motley Fool at www.fool.com.

A TEST

Our discussion to this point can be summarized by considering the following true-false test questions:

1. True or false: Dividends are irrelevant.
2. True or false: Dividend policy is irrelevant.

The first statement is surely false, and the reason follows from common sense. Clearly, investors prefer higher dividends to lower dividends at any single date if the dividend level is held constant at every other date. To be more precise regarding the first question, if the dividend per share at a given date is raised while the dividend per share at every other date is held constant, the stock price will rise. The reason is that the present value of the future dividends must go up if this occurs. This action can be accomplished by management decisions that improve productivity, increase tax savings, strengthen product marketing, or otherwise improve cash flow.

The second statement is true, at least in the simple case we have been examining. Dividend policy by itself cannot raise the dividend at one date while keeping it the same at all other dates. Rather, dividend policy merely establishes the trade-off between dividends at one date and dividends at another date. Once we allow for time value, the present value of the dividend stream is unchanged. In this simple world, dividend policy does not matter because managers choosing either to raise or to lower the current dividend do not affect the current value of their firm. However, we have ignored several real-world factors that might lead us to change our minds; we pursue some of these in subsequent sections.

Concept Questions

17.2a How can an investor create a homemade dividend?

17.2b Are dividends irrelevant?

Real-World Factors Favoring a Low Dividend Payout

17.3

The example we used to illustrate the irrelevance of dividend policy ignored taxes and flotation costs. In this section, we will see that these factors might lead us to prefer a low dividend payout.

TAXES

U.S. tax laws are complex, and they affect dividend policy in a number of ways. The key tax feature has to do with the taxation of dividend income and capital gains. For individual shareholders, *effective* tax rates on dividend income are higher than the tax rates on capital gains. Historically, dividends received have been taxed as ordinary income. Capital gains have been taxed at somewhat lower rates, and the tax on a capital gain is deferred until the stock is sold. This second aspect of capital gains taxation makes the effective tax rate much lower because the present value of the tax is less.²

Recent tax law changes have led to a renewed interest in the effect of taxes on corporate dividend policies. As we previously noted, historically, dividends have been taxed as ordinary income (at ordinary income tax rates). In 2003, under President G. W. Bush, this changed dramatically. Tax rates on dividends and capital gains were lowered from a maximum in the 35–39 percent range to 15 percent, giving corporations a much larger tax incentive to pay dividends. In 2018, the tax rate on dividends was 0 percent, 15 percent, or 20 percent, depending on the individual's marginal tax rate.

FLOTATION COSTS

In our example illustrating that dividend policy doesn't matter, we saw that the firm could sell some new stock if necessary to pay a dividend. As we mentioned in Chapter 15, selling new stock can be very expensive. If we include flotation costs in our argument, then we will find that the value of the stock decreases if we sell new stock.

More generally, imagine two firms identical in every way except that one pays out a greater percentage of its cash flow in the form of dividends. Because the other firm plows back more cash, its equity grows faster. If these two firms are to remain identical, then the one with the higher payout will have to periodically sell some stock to catch up. Because this is expensive, a firm might be inclined to have a low payout.

DIVIDEND RESTRICTIONS

In some cases, a corporation may face restrictions on its ability to pay dividends. For example, as we discussed in Chapter 7, a common feature of a bond indenture is a covenant prohibiting dividend payments above some level. Also, a corporation may be prohibited by state law from paying dividends if the dividend amount exceeds the firm's retained earnings.

²In fact, capital gains taxes can sometimes be avoided altogether. Although we do not recommend this particular tax avoidance strategy, the capital gains tax may be avoided by dying. Your heirs are not considered to have a capital gain, so the tax liability dies when you do. In this instance, you *can* take it with you.

Concept Questions

- 17.3a** What are the tax benefits of low dividends?
17.3b Why do flotation costs favor a low payout?

17.4 Real-World Factors Favoring a High Dividend Payout

In this section, we consider reasons why a firm might pay its shareholders higher dividends even if it means the firm must issue more shares of stock to finance the dividend payments.

In a classic textbook, Benjamin Graham, David Dodd, and Sidney Cottle argue that firms should generally have high dividend payouts because:

1. “The discounted value of near dividends is higher than the present worth of distant dividends.”
2. Between “two companies with the same general earning power and same general position in an industry, the one paying the larger dividend will almost always sell at a higher price.”³³

Two additional factors favoring a high dividend payout have also been mentioned frequently by proponents of this view: The desire for current income and the resolution of uncertainty.

DESIRE FOR CURRENT INCOME

It has been argued that many individuals desire current income. The classic example is the group of retired people and others living on a fixed income (the proverbial widows and orphans). It is argued that this group is willing to pay a premium to get a higher dividend yield. If this is true, then it lends support to the second claim made by Graham, Dodd, and Cottle.

It is easy to see that this argument is irrelevant in our simple case. An individual preferring high current cash flow but holding low-dividend securities can easily sell off shares to provide the necessary funds. Similarly, an individual desiring a low current cash flow but holding high-dividend securities can just reinvest the dividend. This is just our homemade dividend argument again. In a world of no transaction costs, a policy of high current dividends would be of no value to the stockholder.

The current income argument may have relevance in the real world. Here the sale of low-dividend stocks would involve brokerage fees and other transaction costs. These direct cash expenses could be avoided by an investment in high-dividend securities. In addition, the expenditure of the stockholder’s own time in selling securities and the natural (though not necessarily rational) fear of consuming out of principal might further lead many investors to buy high-dividend securities.

Even so, to put this argument in perspective, remember that financial intermediaries such as mutual funds can (and do) perform these “repackaging” transactions for individuals at very low cost. Such intermediaries could buy low-dividend stocks and, through a controlled policy of realizing gains, they could pay their investors at a higher rate.

³³Graham, B., Dodd, D., and Cottle, S., *Security Analysis*. New York: McGraw-Hill, 1962.

TAX AND OTHER BENEFITS FROM HIGH DIVIDENDS

Earlier, we saw that dividends were taxed unfavorably for individual investors (at least until very recently). This fact is a powerful argument for a low payout. However, there are a number of other investors who do not receive unfavorable tax treatment from holding high-dividend yield, rather than low-dividend yield, securities.

Corporate Investors A significant tax break on dividends occurs when a corporation owns stock in another corporation. A corporate stockholder receiving either common or preferred dividends is granted a 50 percent (or more) dividend exclusion (reduced from 70 percent or more in the 2017 Tax Cuts and Jobs Act). Because the 50 percent exclusion does not apply to capital gains, this group is taxed unfavorably on capital gains.

As a result of the dividend exclusion, high-dividend, low-capital gains stocks may be more appropriate for corporations to hold. As we discuss elsewhere, this is why corporations hold a substantial percentage of the outstanding preferred stock in the economy. This tax advantage of dividends also leads some corporations to hold high-yielding stocks instead of long-term bonds because there is no similar tax exclusion of interest payments to corporate bondholders.

Tax-Exempt Investors We have pointed out both the tax advantages and the tax disadvantages of a low dividend payout. Of course, this discussion is irrelevant to those in zero tax brackets. This group includes some of the largest investors in the economy, such as pension funds, endowment funds, and trust funds.

CONCLUSION

Overall, individual investors (for whatever reason) may have a desire for current income and may be willing to pay the dividend tax. In addition, some very large investors such as corporations and tax-free institutions may have a very strong preference for high dividend payouts.

Concept Questions

- 17.4a** Why might some individual investors favor a high dividend payout?
- 17.4b** Why might some nonindividual investors prefer a high dividend payout?

A Resolution of Real-World Factors?

17.5

In the previous sections, we presented some factors that favor a low-dividend policy and others that favor a high-dividend policy. In this section, we discuss two important concepts related to dividends and dividend policy: The information content of dividends and the clientele effect. The first topic illustrates both the importance of dividends in general and the importance of distinguishing between dividends and dividend policy. The second topic suggests that, despite the many real-world considerations we have discussed, the dividend payout ratio may not be as important as we originally imagined.

INFORMATION CONTENT OF DIVIDENDS

To begin, we quickly review some of our earlier discussion. Previously, we examined three different positions on dividends:

1. Based on the homemade dividend argument, dividend policy is irrelevant.
2. Because of tax effects for individual investors and new issue costs, a low-dividend policy is best.
3. Because of the desire for current income and related factors, a high-dividend policy is best.

If you wanted to decide which of these positions is the right one, an obvious way to get started would be to look at what happens to stock prices when companies announce dividend changes. You would find with some consistency that stock prices rise when the current dividend is unexpectedly increased, and they generally fall when the dividend is unexpectedly decreased. What does this imply about any of the three positions just stated?

At first glance, the behavior we describe seems consistent with the third position and inconsistent with the other two. In fact, many writers have argued this position. If stock prices rise in response to dividend increases and fall in response to dividend decreases, then isn't the market saying that it approves of higher dividends?

Other authors have pointed out that this observation doesn't really tell us much about dividend policy. Everyone agrees that dividends are important, all other things being equal. Companies cut dividends only with great reluctance. Thus, a dividend cut is often a signal that the firm is in trouble.

More to the point, a dividend cut is usually not a voluntary, planned change in dividend policy. Instead, it usually signals that management does not think that the current dividend policy can be maintained. As a result, expectations of future dividends should generally be revised downward. The present value of expected future dividends falls, and so does the stock price.

In this case, the stock price declines following a dividend cut because future dividends are generally expected to be lower, not because the firm has changed the percentage of its earnings it will pay out in the form of dividends.

For example, on February 4, 2016, oil company ConocoPhillips announced that it was cutting its dividend by two-thirds, from \$.74 per year to \$.25 per year. The company stated that the drastic fall in oil prices was to blame. Shareholders were in for a big shock. On a typical day, about 7.1 million shares of the company stock traded hands. Following the announcement, about 50 million shares were traded and the stock lost about 9 percent of its value.

Of course, the phenomenon of a stock price decrease in the face of a dividend cut is not restricted to the United States. In February 2016, Australian natural resource company BHP Billiton announced that its annual dividend would be 14 cents, well below the previous year's dividend of 62 cents. In response, the stock dropped by about 5 percent.

In a similar vein, an unexpected increase in the dividend signals good news. Management will raise the dividend only when future earnings, cash flow, and general prospects are expected to rise to such an extent that the dividend will not have to be cut later. A dividend increase is management's signal to the market that the firm is expected to do well. The stock price reacts favorably because expectations of future dividends are revised upward, not because the firm has increased its payout.

In both of these cases, the stock price reacts to the dividend change. The reaction can be attributed to changes in the expected amount of future dividends, not necessarily a change in dividend payout policy. This reaction is called the **information content effect** of the dividend. The fact that dividend changes convey information about the firm to the market makes it difficult to interpret the effect of the dividend policy of the firm.

information content effect

The market's reaction to a change in corporate dividend payout.

THE CLIENTELE EFFECT

In our earlier discussion, we saw that some groups (wealthy individuals, for example) have an incentive to pursue low-payout (or zero-payout) stocks. Other groups (corporations, for example) have an incentive to pursue high-payout stocks. Companies with high payouts will attract one group, and low-payout companies will attract another.

These different groups are called *clienteles*, and what we have described is a **clientele effect**. The clientele effect argument states that different groups of investors desire different levels of dividends. When a firm chooses a particular dividend policy, the only effect is to attract a particular clientele. If a firm changes its dividend policy, then it attracts a different clientele.

What we are left with is a simple supply and demand argument. Suppose 40 percent of all investors prefer high dividends, but only 20 percent of the firms pay high dividends. Here the high-dividend firms will be in short supply; their stock prices will rise. Consequently, low-dividend firms will find it advantageous to switch policies until 40 percent of all firms have high payouts. At this point, the *dividend market* is in equilibrium. Further changes in dividend policy are pointless because all of the clienteles are satisfied. The dividend policy for any individual firm is now irrelevant.

To see if you understand the clientele effect, consider the following statement: In spite of the theoretical argument that dividend policy is irrelevant or that firms should not pay dividends, many investors like high dividends; because of this fact, a firm can boost its share price by having a higher dividend payout ratio. True or false?

The answer is false if clienteles exist. As long as enough high-dividend firms satisfy the dividend-loving investors, a firm won't be able to boost its share price by paying high dividends. An unsatisfied clientele must exist for this to happen, and there is no evidence that this is the case.

clientele effect

The observable fact that stocks attract particular groups based on dividend yield and the resulting tax effects.

Concept Questions

- 17.5a** How does the market react to unexpected dividend changes? What does this tell us about dividends? About dividend policy?
- 17.5b** What is a dividend clientele? All things considered, would you expect a risky firm with significant but highly uncertain growth prospects to have a low or a high dividend payout?

Stock Repurchases: An Alternative to Cash Dividends

Thus far in our chapter, we have considered cash dividends. Cash dividends are not the only way corporations distribute cash. Instead, a company can **repurchase** its own stock. Repurchases (or *buybacks*) have become an increasingly popular tool, and the amount spent on repurchases has become huge. For example, in 2016, about \$536 billion in share repurchases were announced, a 6 percent decrease over the \$572 billion of repurchases in 2015. The record amount of stock buybacks in a single year was the \$589 billion announced in 2007.

Another way to see how important repurchases have become is to compare them to cash dividends. Consider Figure 17.3, which shows the aggregate real (inflation-adjusted) dividends and stock repurchases by publicly held U.S. industrial firms for the period 1971–2015, along with the combined total. Aggregate real dividends have grown relatively

17.6

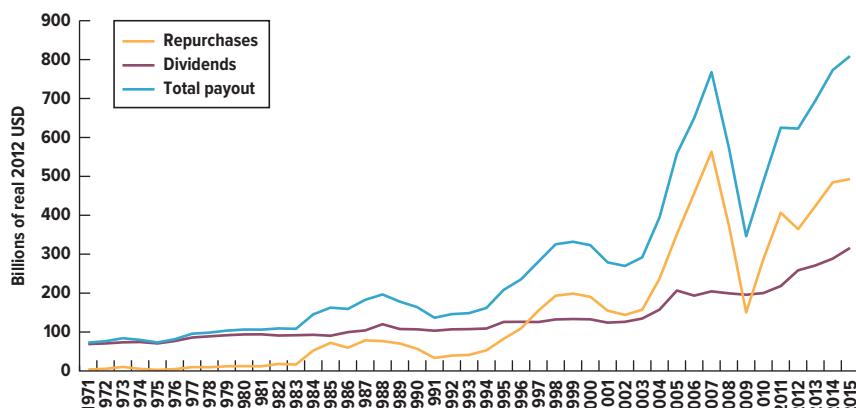
stock repurchase

The purchase, by a corporation, of its own shares of stock; also known as a *buyback*.

FIGURE 17.3

**Aggregate Real
(2012) Dividends and
Stock Repurchases
by Publicly Held U.S.
Industrial Firms:
1971–2015**

SOURCE: Redrawn by authors using Compustat data, following Farre-Mensa, J., Michalev, R., and Schmaltz, M., "Payout Policy," *Annual Review of Financial Economics* 6, 2014, pp. 75–134.



steadily through time, but repurchases have exploded in the last two decades. They reached a peak in 2007 of about 2.5 times the size of aggregate dividends. Repurchases plunged in the 2008–2009 recession as firms conserved cash, but they rebounded in 2010.

Share repurchases are typically accomplished in one of three ways. First, companies may purchase their own stock, just as anyone would buy shares of a particular stock. In these *open market purchases*, the firm does not reveal itself as the buyer. The seller does not know whether the shares were sold back to the firm or sold to another investor.

Second, the firm could institute a *tender offer*. Here, the firm announces to all of its stockholders that it is willing to buy a fixed number of shares at a specific price. For example, suppose Arts and Crafts (A&C), Inc., has 1 million shares of stock outstanding, with a stock price of \$50 per share. The firm makes a tender offer to buy back 300,000 shares at \$60 per share. A&C chooses a price above \$50 to induce shareholders to sell, that is, tender, their shares. In fact, if the tender price is set high enough, shareholders may very well want to sell more than the 300,000 shares. In the extreme case where all outstanding shares are tendered, A&C will buy back 3 out of every 10 shares that a shareholder holds.

Finally, firms may repurchase shares from specific individual stockholders. This procedure has been called a *targeted repurchase*. For example, suppose the International Biotechnology Corporation purchased approximately 10 percent of the outstanding stock of the Prime Robotics Company (P-R Co.) in April at around \$38 per share. At that time, International Biotechnology announced to the Securities and Exchange Commission that it might eventually try to take control of P-R Co. In May, P-R Co. repurchased the International Biotechnology holdings at \$48 per share, well above the market price at that time. This offer was not extended to other shareholders.

CASH DIVIDENDS VERSUS REPURCHASE

Imagine an all-equity company with excess cash of \$300,000. The firm pays no dividends, and its net income for the year just ended is \$49,000. The market value balance sheet at the end of the year is represented here:

Market Value Balance Sheet (before paying out excess cash)			
Excess cash	\$ 300,000	Debt	\$ 0
Other assets	700,000	Equity	1,000,000
Total	\$1,000,000	Total	\$1,000,000

There are 100,000 shares outstanding. The total market value of the equity is \$1 million, so the stock sells for \$10 per share. Earnings per share (EPS) are $\$49,000/100,000 = \$.49$, and the price-earnings ratio (PE) is $\$10/\$.49 = 20.4$.

One option the company is considering is a $\$300,000/100,000 = \3 per share extra cash dividend. Alternatively, the company is thinking of using the money to repurchase $\$300,000/\$10 = 30,000$ shares of stock.

If commissions, taxes, and other imperfections are ignored in our example, the stockholders shouldn't care which option is chosen. Does this seem surprising? It shouldn't, really. What is happening here is that the firm is paying out \$300,000 in cash. The new balance sheet is represented here:

Market Value Balance Sheet (after paying out excess cash)			
Excess cash	\$ 0	Debt	\$ 0
Other assets	<u>700,000</u>	Equity	<u>700,000</u>
Total	<u><u>\$700,000</u></u>	Total	<u><u>\$700,000</u></u>

If the cash is paid out as a dividend, there are still 100,000 shares outstanding, so each is worth \$7.

The fact that the per-share value fell from \$10 to \$7 is not a cause for concern. Consider a stockholder who owns 100 shares. At \$10 per share before the dividend, the total value is \$1,000.

After the \$3 dividend, this same stockholder has 100 shares worth \$7 each, for a total of \$700, plus $100 \times \$3 = \300 in cash, for a combined total of \$1,000. This illustrates what we saw early on: A cash dividend doesn't affect a stockholder's wealth if there are no imperfections. In this case, the stock price fell by \$3 when the stock went ex dividend.

Also, because total earnings and the number of shares outstanding haven't changed, EPS is still 49 cents. The price-earnings ratio falls to $\$7/\$.49 = 14.3$. The reason why we are looking at accounting earnings and PE ratios will be apparent in just a moment.

Alternatively, if the company repurchases 30,000 shares, there are 70,000 shares left outstanding. The balance sheet looks the same:

Market Value Balance Sheet (after share repurchase)			
Excess cash	\$ 0	Debt	\$ 0
Other assets	<u>700,000</u>	Equity	<u>700,000</u>
Total	<u><u>\$700,000</u></u>	Total	<u><u>\$700,000</u></u>

The company is worth \$700,000 again, so each remaining share is worth $\$700,000/70,000 = \10 . Our stockholder with 100 shares is obviously unaffected. For example, if she was so inclined, she could sell 30 shares and end up with \$300 in cash and \$700 in stock, just as she has if the firm pays the cash dividend. This is another example of a homemade dividend.

In this second case, EPS goes up because total earnings remain the same while the number of shares goes down. The new EPS is $\$49,000/70,000 = \0.70 . The important thing to notice is that the PE ratio is $\$10/\$0.70 = 14.3$, as it was following the dividend.

This example illustrates the important point that, if there are no imperfections, a cash dividend and a share repurchase are essentially the same thing. This is another illustration of dividend policy irrelevance when there are no taxes or other imperfections.

REAL-WORLD CONSIDERATIONS IN A REPURCHASE

The example we have just described shows that a repurchase and a cash dividend are the same thing in a world without taxes and transaction costs. In the real world, there are some accounting differences between a share repurchase and a cash dividend, but the most important difference is in the tax treatment.

Under current tax law, a repurchase has a significant tax advantage over a cash dividend. A dividend is taxed, and a shareholder has no choice about whether or not to receive the dividend. In a repurchase, a shareholder pays taxes only if (1) the shareholder actually chooses to sell and (2) the shareholder has a capital gain on the sale.

For example, suppose a dividend of \$1 per share is taxed at ordinary rates. Investors in the 28 percent tax bracket who own 100 shares of the security pay $\$100 \times .28 = \28 in taxes. Selling shareholders would pay far lower taxes if \$100 worth of stock were repurchased. This is because taxes are paid only on the profit from a sale. The gain on a sale would be only \$40 if shares sold at \$100 were originally purchased at \$60. The capital gains tax would be $.28 \times \$40 = \11.20 . Note that the 2003 reductions in dividend and capital gains tax rates do not change the fact that a repurchase has a potentially large tax edge.

To give a few recent examples, in January 2017, Apple announced that it had repurchased \$11 billion of its stock in the previous quarter. And General Motors announced that it was increasing its \$9 billion repurchase, which it had begun in 2015, by another \$5 billion. Also in January 2017, both Pfizer and Swiss drugmaker Novartis announced repurchases of \$5 billion.

IBM is well known for its aggressive repurchasing policies. In the first nine months of 2016, it repurchased \$2.6 billion of its own stock. Since 2003, the company had spent about \$138.8 billion on buybacks through the end of 2016. In fact, from the beginning of 2003 through the end of 2016, the number of shares in the company fell from 1.72 billion shares to 951 million shares.

One thing to note is that not all announced stock repurchase plans are completed. Based on research covering the 2004–2007 period, average completion rates were only 81 percent.⁴

SHARE REPURCHASE AND EPS

You may read in the popular financial press that a share repurchase is beneficial because it causes earnings per share to increase. As we have seen, this will happen. The reason is that a share repurchase reduces the number of outstanding shares, but it has no effect on total earnings. As a result, EPS rises.

⁴See A. A. Bonaimé, "Mandatory Disclosure and Firm Behavior: Evidence from Share Repurchases," *The Accounting Review* 90 (2015).

The financial press may place undue emphasis on EPS figures in a repurchase agreement. In our preceding example, we saw that the value of the stock wasn't affected by the EPS change. In fact, the PE ratio was exactly the same when we compared a cash dividend to a repurchase.

Concept Questions

- 17.6a** Why might a stock repurchase make more sense than an extra cash dividend?
- 17.6b** What is the effect of a stock repurchase on a firm's EPS? Its PE?

What We Know and Do Not Know about Dividend and Payout Policies

17.7

DIVIDENDS AND DIVIDEND PAYERS

As we have discussed, there are numerous good reasons favoring a dividend policy of low (or no) payout. Nonetheless, in the United States, aggregate dividends paid are quite large. For example, in 1978, U.S. industrial firms listed on the major exchanges paid \$31.3 billion in total dividends. By 2000, that number had risen to \$101.6 billion (unadjusted for inflation), an increase of over 200 percent (after adjusting for inflation, the increase is smaller, 22.7 percent, but still substantial).

While we know dividends are large in the aggregate, we also know that the number of companies that pay dividends has declined. Over the same 1978–2000 period, the number of industrial companies paying dividends declined from over 2,000 to just under 1,000, and the percentage of these firms paying dividends declined 65 percent, to 19 percent.⁵

The fact that aggregate dividends grew while the number of payers fell so sharply seems a bit paradoxical, but the explanation is straightforward: Dividend payments are heavily concentrated in a relatively small set of large firms. In 2000, for example, about 80 percent of aggregate dividends were paid by just 100 firms. The top 25 payers, which include such well-known giants as ExxonMobil and General Electric, collectively paid about 55 percent of all dividends. The reason that dividends grew while dividend payers shrank is that the decline in dividend payers is almost entirely due to smaller firms, which tend to pay smaller dividends in the first place.

One important reason that the percentage of dividend-paying firms has declined is that the population of firms has changed. There has been a huge increase in the number of newly listed firms over the last 25 or so years. Newly listed firms tend to be younger and less profitable. Such firms need their internally generated cash to fund growth and typically do not pay dividends.

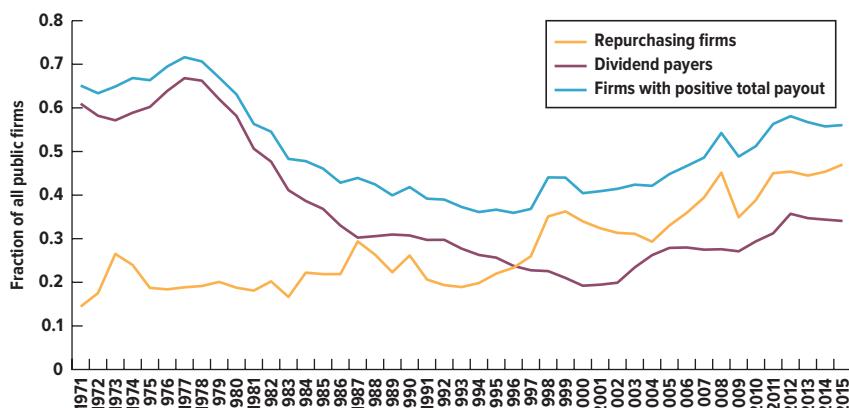
Another factor at work is that firms appear to be more likely to begin making payouts using share repurchases, which are flexible, rather than committing to making cash distributions. Such a policy seems quite sensible given our previous discussions. However, after

⁵These figures and those in the following paragraph are from H. DeAngelo, L. DeAngelo, and D. J. Skinner, "Are Dividends Disappearing? Dividend Concentration and the Consolidation of Earnings," *Journal of Financial Economics* 72 (2004).

FIGURE 17.4

Proportion of Dividend Payers, Repurchasers, and Firms with Positive Total Payout among All Publicly Held U.S. Industrial Firms: 1971–2015

SOURCE: Redrawn by authors using Compustat data, following Farre-Mensa, J., Michaely, R., and Schmaltz, M., "Payout Policy," *Annual Review of Financial Economics* 6, 2014, pp. 75–134.



controlling for the changing mix of firms and the increase in share repurchasing activity, there still appears to be a decreased propensity to pay dividends among certain types of older, better established firms, though further research is needed on this question.

The fact that the number of dividend-paying firms has declined so sharply is an interesting phenomenon. Making matters even more interesting is evidence showing that the trend may have begun to reverse itself. Take a look at Figure 17.4, which shows the percentage of industrial firms paying dividends over the period 1971–2015, along with the percentage of (1) firms doing repurchases and (2) firms with a positive payout of one type or the other (or both). As shown, there is a pronounced downward trend, but that trend appears to bottom out in 2000 and then sharply reverse in 2002. So what's going on?

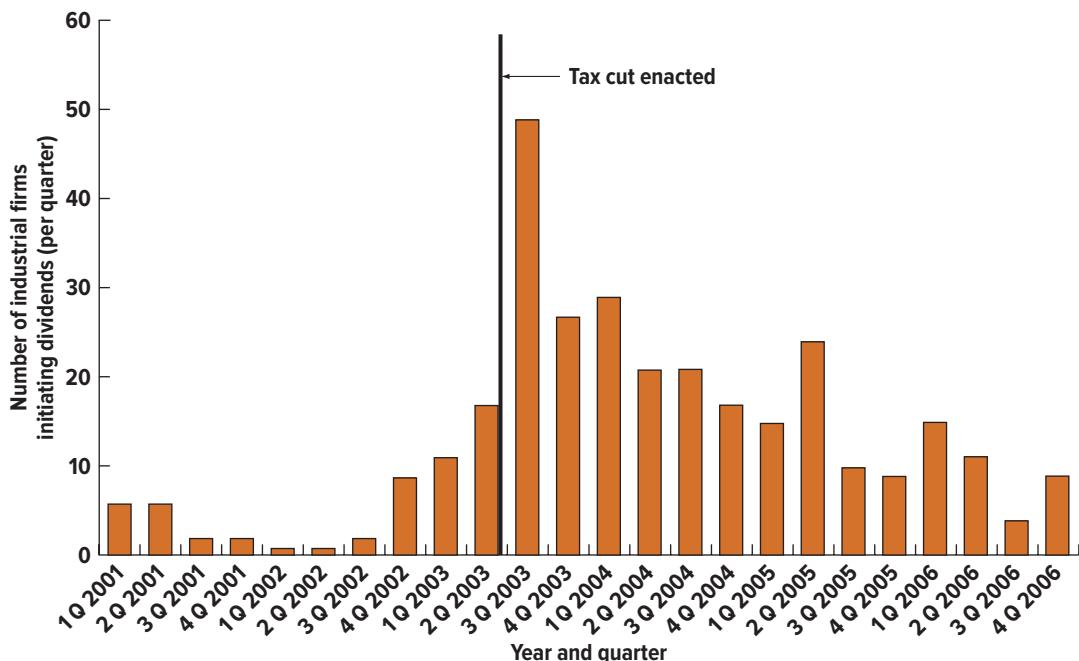
Part of the apparent rebound in Figure 17.4 is probably an illusion. The percentage of firms paying dividends rose because nonpayers dropped out in large numbers.⁶ The number of firms listed on the major stock markets dropped sharply, from over 5,000 to under 4,000, during the period 2000–2005. About 2,000 firms delisted over this period, 98 percent of which were not dividend payers. By 2013, the number of listed firms had declined to below 3,000, and the percentage of dividend payers reached 36 percent.

Once we control for the drop-out problem, there is still an increase in the number of dividend payers, but it happens in 2003. As shown in Figure 17.5, the uptick is concentrated in the months following May 2003. What is so special about this month? The answer is that in May 2003, top personal tax rates on dividends were slashed from about 38 to 15 percent. Consistent with our earlier tax arguments, a reduction in personal tax rates led to increases in dividends.

It is important not to read too much into Figure 17.5. It seems clear that the reduction in tax rates did have an effect, but, on balance, what we see is a few hundred firms initiating dividends. There are still thousands of firms that did not initiate dividends, even though the tax rate reduction was very large. The evidence suggests that tax rates matter, but they are not a primary determinant of dividend policy. This interpretation is consistent with the results of a 2005 survey of financial executives, more than two-thirds of whom said that the tax rate cut probably or definitely would not affect their dividend policies.⁷

⁶These numbers and this explanation are from R. Chetty and E. Saez, "The Effects of the 2003 Dividend Tax Cut on Corporate Behavior: Interpreting the Evidence," *American Economic Review Papers and Proceedings* 96 (2006).

⁷See A. P. Brav, J. R. Graham, C. R. Harvey, and R. Michaely, "Managerial Response to the May 2003 Dividend Tax Cut," *Financial Management* 37 (2008), pp. 611–624.

FIGURE 17.5 Regular Dividend Initiations, 2001–2006

SOURCE: Brav, A. P. et al., "Managerial Response to the May 2003 Dividend Tax Cut," *Financial Management* 37, 2008, pp. 611–624.

A second force that may be at work over time is the maturing of many of the (surviving) newly listed firms we mentioned earlier. As these firms have become better established, their profitability has increased (and, potentially, their investment opportunities have decreased), and they have begun to pay dividends.

A third factor that may be contributing to the increase in the number of dividend payers is a little more subtle. The technology-heavy NASDAQ index plummeted in the spring of 2000 (due to the “dot-com” crash), and it became clear that many newly listed companies were likely to fail. Shortly thereafter, major accounting scandals at companies such as Enron and WorldCom left investors unsure of the trustworthiness of reported earnings. In such an environment, companies may have chosen to initiate dividends in an attempt to signal to investors that they had the cash to make dividend payments now and in the future.

The apparent reversal in the decline of dividend payers is a recent phenomenon, so its significance remains to be seen. It may prove to be just a transient event in the middle of a long decline. We will have to wait and see.

CORPORATIONS SMOOTH DIVIDENDS

As we previously observed, dividend cuts are frequently viewed as very bad news by market participants. As a result, companies only cut dividends when there is no other acceptable alternative. For the same reason, companies are also reluctant to increase dividends unless they are sure the new dividend level can be sustained.

In practice, what we observe is that dividend-paying companies tend to raise dividends only after earnings have risen, and they don’t increase or cut dividends in response to

temporary earnings fluctuations. In other words, (1) dividend growth lags earnings growth and (2) dividend growth will tend to be much smoother than earnings growth.

To see how important dividend stability and steady growth are to financial managers, consider that, in 2016, 2,634 companies in the United States increased their dividend payments, while only 659 companies decreased their dividend payments. Two companies with long histories of dividend increases are Procter & Gamble and Colgate-Palmolive. At the end of 2016, Procter & Gamble had increased its dividend for 61 consecutive years, and Colgate-Palmolive had increased its dividend for 53 consecutive years. Overall, as of early 2017, 51 companies in the S&P 500 had increased dividends for at least 25 consecutive years.

PUTTING IT ALL TOGETHER

Much of what we have discussed in this chapter (and much of what we know about dividends from decades of research) can be pulled together and summarized in the following five observations:⁸

1. Aggregate dividend and stock repurchases are massive, and they have increased steadily in nominal and real terms over the years.
2. Dividends are heavily concentrated among a relatively small number of large, mature firms.
3. Managers are very reluctant to cut dividends, normally doing so only due to firm-specific problems.
4. Managers smooth dividends, raising them slowly and incrementally as earnings grow.
5. Stock prices react to unanticipated changes in dividends.

The challenge now is to fit these five pieces into a reasonably coherent picture. With regard to payouts in general, meaning the combination of stock repurchases and cash dividends, a simple life cycle theory fits Points 1 and 2. The key ideas are straightforward. First, relatively young and less profitable firms generally should not make cash distributions. They need the cash to fund investments (and flotation costs discourage the raising of outside cash).

As a firm matures, it begins to generate free cash flow (which, you will recall, is internally generated cash flow beyond that needed to fund profitable investment activities). Significant free cash flow can lead to agency problems if it is not distributed. Managers may become tempted to pursue empire building or otherwise spend the excess cash in ways not in the shareholders' best interests. Firms come under pressure to make distributions rather than hoard cash. And, consistent with what we observe, we expect large firms with a history of profitability to make large distributions.

The life cycle theory says that firms trade off the agency costs of excess cash retention against the potential future costs of external equity financing. A firm should begin making distributions when it generates sufficient internal cash flow to fund its investment needs now and into the foreseeable future.

The more complex issue concerns the type of distribution, cash dividends versus repurchases. The tax argument in favor of repurchases is a clear and strong one. Further,

⁸This list is distilled in part from a longer list in DeAngelo, H., and DeAngelo, L., "Payout Policy Pedagogy: What Matters and Why," *European Financial Management* 13, 2007.

repurchases are a much more flexible option (and managers greatly value financial flexibility), so the question is: Why would firms ever choose a cash dividend?

If we are to answer this question, we have to ask a different question. What can a cash dividend accomplish that a share repurchase cannot accomplish? One answer is that when a firm makes a commitment to pay a cash dividend now and into the future, it sends a two-part signal to the markets. As we have already discussed, one signal is that the firm anticipates being profitable, with the ability to make the payments on an ongoing basis. Note that a firm cannot benefit by trying to fool the market in this regard because the firm would ultimately be punished when it couldn't make the dividend payment (or couldn't make it without relying on external financing). A cash dividend may let a firm distinguish itself from less profitable rivals.

A second, and more subtle, signal takes us back to the agency problem of free cash flow. By committing to pay cash dividends now and in the future, the firm signals that it won't be hoarding cash (or at least not as much cash), thereby reducing agency costs and enhancing shareholder wealth.

This two-part signaling story is consistent with Points 3–5 above, but an obvious objection remains. Why don't firms just commit to a policy of setting aside whatever money would be used to pay dividends and use it instead to buy back shares? After all, either way, a firm is committing to pay out cash to shareholders.

A fixed repurchase strategy suffers from two drawbacks. The first is verifiability. A firm could announce an open market repurchase and then not do it. By suitably fudging its books, it would be some time before the deception was discovered. It would be necessary for shareholders to develop a monitoring mechanism, meaning some sort of way for stockholders to know for sure that the repurchase was in fact done. Such a mechanism wouldn't be difficult to build (it could be a simple trustee relationship such as we observe in the bond markets), but it currently does not exist. Of course, a tender offer repurchase needs little or no verification, but such offers have expenses associated with them. The beauty of a cash dividend is that it needs no monitoring. A firm is forced to cut and mail checks four times per year, year in and year out.

A second objection to a fixed repurchase strategy is more controversial. Suppose managers, as insiders, are better able than stockholders to judge whether their stock price is too high or too low. (Note that this idea does not conflict with semistrong market efficiency if inside information is the reason.) In this case, a fixed repurchase commitment forces management to buy back stock even in circumstances when the stock is overvalued. In other words, it forces management into making negative NPV investments.

More research on the cash dividend versus share repurchase question is needed, but the historical trend seems to be favoring continued growth in repurchases relative to dividends.

Total corporate payouts seem to be relatively stable over time at roughly 20 percent of aggregate earnings (see Figure 17.3), but repurchases are becoming a larger portion of that total. The split reached about 50-50 in the latter part of the 1990s, but it looks like aggregate repurchases have recently passed aggregate dividends.

One aspect of aggregate cash dividends that has not received much attention is that there may be a strong legacy effect. Before 1982, the regulatory status of stock repurchases was somewhat murky, creating a significant disincentive. In 1982, the SEC, after years of debate, created a clear set of guidelines for firms to follow, thereby making repurchases much more attractive.

The legacy effect arises because many of the giant firms that pay such a large portion of aggregate dividends were paying dividends before (and perhaps long before) 1982. To the extent that these firms are unwilling to cut their dividends, aggregate cash dividends will be

large, but only because of a “lock-in” effect for older firms. If locked-in, legacy payers account for much of the aggregate dividend, what we should observe is (1) a sharply reduced tendency for maturing firms to initiate dividends and (2) a growth in repurchases relative to cash dividends over time. We actually do see evidence of both of these trends; legacy effects alone can’t account for all cash dividend payers.

The Pros and Cons of Paying Dividends	
Pros	Cons
<ol style="list-style-type: none"> 1. Cash dividends can underscore good results and provide support to the stock price. 2. Dividends may attract institutional investors who prefer some return in the form of dividends. A mix of institutional and individual investors may allow a firm to raise capital at lower cost because of the ability of the firm to reach a wider market. 3. Stock price usually increases with the announcement of a new or increased dividend. 4. Dividends absorb excess cash flow and may reduce agency costs that arise from conflicts between management and shareholders. 	<ol style="list-style-type: none"> 1. Dividends are taxed to recipients. 2. Dividends can reduce internal sources of financing. Dividends may force the firm to forgo positive NPV projects or to rely on costly external equity financing. 3. Once established, dividend cuts are hard to make without adversely affecting a firm’s stock price.

SOME SURVEY EVIDENCE ON DIVIDENDS

A recent study surveyed a large number of financial executives regarding dividend policy. One of the questions asked was, “Do these statements describe factors that affect your company’s dividend decisions?” Table 17.1 shows some of the results.

As shown in Table 17.1, financial managers are very disinclined to cut dividends. Moreover, they are very conscious of their previous dividends and desire to maintain a relatively steady dividend. In contrast, the cost of external capital and the desire to attract “prudent man” investors (those with fiduciary duties) are less important.

TABLE 17.1

Survey Responses on Dividend Decisions*

SOURCE: Adapted from Table 4 of Brav, A. et al., “Payout Policy in the 21st Century,” *Journal of Financial Economics*, 2005.

Do These Statements Affect Your Dividend Policy?	Percent Who Agree or Strongly Agree
1. Avoiding dividend cuts	93.8%
2. Maintaining a “smooth” dividend over time	89.6
3. Size of recently paid dividends	88.2
4. Making sure that any changes we make won’t have to be reversed later	77.9
5. The rate at which dividends are changing or growing	66.7
6. The cost of cutting dividends exceeds the cost of raising external capital	42.8
7. Using dividends to attract investors subject to “prudent man” investment restrictions	41.7

*Survey respondents were asked the question, “Do these statements describe factors that affect your company’s dividend decisions?”

IN THEIR OWN WORDS ...

Fischer Black on Why Firms Pay Dividends

I think investors like dividends. They believe that dividends enhance stock value (given the firm's prospects), and they feel uncomfortable spending out of their capital.

We see evidence for this everywhere: Investment advisers and institutions treat a high-yield stock as both attractive and safe, financial analysts value a stock by predicting and discounting its dividends, financial economists study the relation between stock prices and actual dividends, and investors complain about dividend cuts.

What if investors were neutral toward dividends? Investment advisers would tell clients to spend indifferently from income and capital and, if taxable, to avoid income; financial analysts would ignore dividends in valuing stocks; financial economists would treat stock price and the discounted value of dividends as equal, even when stocks are mispriced; and a firm would apologize to its taxable investors when forced by an accumulated earnings tax to pay dividends. This is not what we observe.

Furthermore, changing dividends seems a poor way to tell the financial markets about a firm's prospects. Public statements can better detail the firm's prospects and have more impact on both the speaker's and the firm's reputations.

I predict that under current tax rules, dividends will gradually disappear.

The late Fischer Black was a partner at Goldman, Sachs & Co., an investment banking firm. Before that, he was a professor of finance at MIT. He is one of the fathers of option pricing theory, and he is widely regarded as one of the preeminent financial scholars. He is well known for his creative ideas, many of which were dismissed at first only to become part of accepted lore when others finally came to understand them. He is sadly missed by his colleagues.

Table 17.2 is drawn from the same survey, but here the responses are to the question, "How important are the following factors to your company's dividend decision?" Not surprisingly given the responses in Table 17.1 and our earlier discussion, the highest priority is maintaining a consistent dividend policy. The next several items are also consistent with our previous analysis. Financial managers are very concerned about earnings stability and future earnings levels in making dividend decisions, and they consider the availability of good investment opportunities. Survey respondents also believed that attracting both institutional and individual (retail) investors was relatively important.

In contrast to our discussion of taxes and flotation costs in the earlier part of this chapter, the financial managers in this survey did not think that personal taxes paid on dividends by shareholders were very important. Even fewer financial managers thought that equity flotation costs were relevant.

How Important Are the Following?	Percent Who Think This Is Important or Very Important
1. Being consistent with our historic dividend policy	84.1%
2. Future earnings stability	71.9
3. Sustainable earnings changes	67.1
4. Attracting institutional investors	52.5
5. Good quality investments	47.6
6. Attracting retail investors	44.5
7. Personal taxes paid by our shareholders on dividends we pay	21.1
8. Costs associated with issuing new equity	9.3

TABLE 17.2

Survey Responses on Dividend Decisions*

SOURCE: Adapted from Table 5 of Brav, A. et al., "Payout Policy in the 21st Century," *Journal of Financial Economics*, 2005.

*Survey respondents were asked the question, "How important are the following factors to your company's dividend decision?"

17.8 Stock Dividends and Stock Splits

stock dividend

A payment made by a firm to its owners in the form of stock, diluting the value of each share outstanding.

stock split

An increase in a firm's shares outstanding without any change in owners' equity.

Another type of dividend is paid out in shares of stock. This type of dividend is called a **stock dividend**. A stock dividend is not a true dividend because it is not paid in cash. The effect of a stock dividend is to increase the number of shares that each owner holds. Because there are more shares outstanding, each is worth less.

A stock dividend is commonly expressed as a percentage; for example, a 20 percent stock dividend means that a shareholder receives one new share for every five currently owned (a 20 percent increase). Because every shareholder receives 20 percent more stock, the total number of shares outstanding rises by 20 percent. As we will see in a moment, the result is that each share of stock is worth about 20 percent less.

A **stock split** is essentially the same thing as a stock dividend, except that a split is expressed as a ratio instead of a percentage. When a split is declared, each share is split up to create additional shares. For example, in a three-for-one stock split, each old share is split into three new shares.

SOME DETAILS ABOUT STOCK SPLITS AND STOCK DIVIDENDS

Stock splits and stock dividends have essentially the same impacts on the corporation and the shareholder: They increase the number of shares outstanding and reduce the value per share. The accounting treatment is not the same and it depends on two things: (1) Whether the distribution is a stock split or a stock dividend and (2) the size of the stock dividend if it is called a dividend. In recent years, stock splits have slowed considerably. During the 1990s, an average of 64 S&P 500 companies split each year. From 2008 through 2012, the number fell to about 12 per year.

By convention, stock dividends of less than 20 to 25 percent are called *small stock dividends*. The accounting procedure for such a dividend is discussed next. A stock dividend greater than this range of 20 to 25 percent is called a *large stock dividend*. Large stock dividends are not uncommon. For example, the Comcast two-for-one stock split we discussed at the beginning of the chapter was to be in the form of a 100 percent stock dividend. In June 2016, Facebook announced its 200 percent stock dividend in the form of a three-for-one stock dividend that created the company's nonvoting Class C shares. Except for some relatively minor accounting differences, a stock dividend has the same effect as a stock split.



Information on upcoming stock splits is available on the splits calendar at www.investmenthouse.com and finance.yahoo.com.

Example of a Small Stock Dividend The Peterson Co., a consulting firm specializing in difficult accounting problems, has 10,000 shares of stock outstanding, each selling at \$66. The total market value of the equity is $\$66 \times 10,000 = \$660,000$. With a 10 percent stock dividend, each stockholder receives one additional share for each 10 owned, and the total number of shares outstanding after the dividend is 11,000.

Before the stock dividend, the equity portion of Peterson's balance sheet might look like this:

Common stock (\$1 par, 10,000 shares outstanding)	\$ 10,000
Capital in excess of par value	200,000
Retained earnings	<u>290,000</u>
Total owners' equity	<u><u>\$500,000</u></u>

A seemingly arbitrary accounting procedure is used to adjust the balance sheet after a small stock dividend. Because 1,000 new shares are issued, the common stock account is increased by \$1,000 (1,000 shares at \$1 par value each), for a total of **\$11,000**. The market

price of \$66 is \$65 greater than the par value, so the “excess” of $\$65 \times 1,000$ shares = \$65,000 is added to the capital surplus account (capital in excess of par value), producing a total of **\$265,000**.

Total owners’ equity is unaffected by the stock dividend because no cash has come in or out, so retained earnings are reduced by the entire \$66,000, leaving **\$224,000**. The net effect of these machinations is that Peterson’s equity accounts now look like this:

Common stock (\$1 par, 11,000 shares outstanding)	\$ 11,000
Capital in excess of par value	265,000
Retained earnings	224,000
Total owners’ equity	\$500,000

Example of a Stock Split A stock split is conceptually similar to a stock dividend, but it is commonly expressed as a ratio. For example, in a three-for-two split, each shareholder receives one additional share of stock for each two held originally, so a three-for-two split amounts to a 50 percent stock dividend. Again, no cash is paid out, and the percentage of the entire firm that each shareholder owns is unaffected.

The accounting treatment of a stock split is a little different from (and simpler than) that of a stock dividend. Suppose Peterson decides to declare a two-for-one stock split. The number of shares outstanding will double to **20,000**, and the par value will be halved to **\$.50** per share. The owners’ equity after the split is represented as follows:

Common stock (\$.50 par, 20,000 shares outstanding)	\$ 10,000
Capital in excess of par value	200,000
Retained earnings	290,000
Total owners’ equity	\$500,000



For a list of recent stock splits, try www.stockspplits.net.

Note that, for all three of the categories, the figures on the right are completely unaffected by the split. The only changes are in the par value per share and the number of shares outstanding. Because the number of shares has doubled, the par value of each is cut in half.

Example of a Large Stock Dividend In our example, if a 100 percent stock dividend were declared, 10,000 new shares would be distributed, so **20,000** shares would be outstanding. At a **\$1** par value per share, the common stock account would rise by \$10,000, for a total of **\$20,000**. The retained earnings account would be reduced by \$10,000, leaving **\$280,000**. The result would be the following:

Common stock (\$1 par, 20,000 shares outstanding)	\$ 20,000
Capital in excess of par value	200,000
Retained earnings	280,000
Total owners’ equity	\$500,000

VALUE OF STOCK SPLITS AND STOCK DIVIDENDS

The laws of logic tell us that stock splits and stock dividends can (1) leave the value of the firm unaffected, (2) increase its value, or (3) decrease its value. Unfortunately, the issues are complex enough that we cannot easily determine which of the three relationships holds.

The Benchmark Case A strong case can be made that stock dividends and splits do not change either the wealth of any shareholder or the wealth of the firm as a whole. In our

preceding example, the equity had a total market value of \$660,000. With the small stock dividend, the number of shares increased to 11,000, so it seems that each would be worth $\$660,000/11,000 = \60 .

For example, a shareholder who had 100 shares worth \$66 each before the dividend would have 110 shares worth \$60 each afterward. The total value of the stock is \$6,600 either way; so the stock dividend doesn't really have any economic effect.

After the stock split, there are 20,000 shares outstanding, so each should be worth $\$660,000/20,000 = \33 . In other words, the number of shares doubles and the price halves. From these calculations, it appears that stock dividends and splits are just paper transactions.

Although these results are relatively obvious, reasons are often given to suggest that there may be some benefits to these actions. The typical financial manager is aware of many real-world complexities; for that reason, the stock split or stock dividend decision is not treated lightly in practice.

trading range

The price range between the highest and lowest prices at which a stock is traded.

Popular Trading Range Proponents of stock dividends and stock splits frequently argue that a security has a proper **trading range**. When the security is priced above this level, many investors do not have the funds to buy the common trading unit of 100 shares, called a *round lot*. Although securities can be purchased in *odd-lot* form (fewer than 100 shares), the commissions are greater. Firms will split the stock to keep the price in this trading range.

For example, Microsoft has split nine times since the company went public in 1986. The stock has split three-for-two on two occasions and two-for-one a total of seven times. So for every share of Microsoft you owned in 1986 when the company first went public, you would own 288 shares as of the most recent stock split. Similarly, since Walmart went public in 1970, it has split its stock two-for-one 11 times, and Apple has split seven-for-one once and two-for-one three times since going public in 1980. For a really long split history, consider Procter & Gamble, which has split five-for-one twice, 1.5-to-1 once, and two-for-one eight times since 1920. Each share of P&G purchased prior to the company's first stock split would now be worth 9,600 shares.

Although this argument is a popular one, its validity is questionable for a number of reasons. Mutual funds, pension funds, and other institutions have steadily increased their trading activity since World War II and now handle a sizable percentage of total trading volume (on the order of 90 percent of NYSE trading volume, for example). Because these institutions buy and sell in huge amounts, the individual share price is of little concern.

Furthermore, we sometimes observe share prices that are quite large that do not appear to cause problems. To take a well-known case, Berkshire Hathaway, a widely respected company headed by legendary investor Warren Buffett, sold for about \$300,000 per share in early 2018.

Finally, there is evidence that stock splits may actually decrease the liquidity of the company's shares. Following a two-for-one split, the number of shares traded should more than double if liquidity is increased by the split. This doesn't appear to happen, and the reverse is sometimes observed.

REVERSE SPLITS

reverse split

A stock split in which a firm's number of shares outstanding is reduced.

A less frequently encountered financial maneuver is the **reverse split**. For example, in May 2017, Cobalt Energy announced a 1-for-15 reverse stock split. Also in May 2017, Xerox underwent a 1-for-4 reverse split. In a 1-for-4 reverse split, each investor exchanges 4 old shares for one new share. The par value is increased by a factor of 4 in the process. In what

will probably be one of the biggest reverse splits ever (in terms of market cap), banking giant Citigroup announced in March 2011 that it would do a 1-for-10 reverse split, thereby reducing the number of shares outstanding from 29 billion to 2.9 billion. As with stock splits and stock dividends, a case can be made that a reverse split has no real effect.

Given real-world imperfections, three related reasons are cited for reverse splits. First, transaction costs to shareholders may be less after the reverse split. Second, the liquidity and marketability of a company's stock might be improved when its price is raised to the popular trading range. Third, stocks selling at prices below a certain level are not considered respectable, meaning that investors underestimate these firms' earnings, cash flow, growth, and stability. Some financial analysts argue that a reverse split can achieve instant respectability. As was the case with stock splits, none of these reasons is particularly compelling, especially not the third one.

There are two other reasons for reverse splits. First, stock exchanges have minimum price per share requirements. A reverse split may bring the stock price up to such a minimum. For example, NASDAQ begins the delisting process for companies whose stock price drops below \$1 per share for 30 days. Following the collapse of the Internet boom in 2001–2002, a large number of Internet-related companies found themselves in danger of being delisted and used reverse splits to boost their stock prices. Second, companies sometimes perform reverse splits and, at the same time, buy out any stockholders who end up with less than a certain number of shares.

For example, in January 2017, Lime Energy completed a reverse/forward split. In this case, the company first did a 1-for-300 reverse stock split and then repurchased all shares held by stockholders with less than one share of stock, eliminating smaller shareholders thus reducing the total number of shareholders. This process allowed the company to delist its stock, or “go dark.” What made the proposal especially imaginative was that immediately after the reverse split, the company did a 300-for-1 ordinary split to restore the stock to its original cost!

Concept Questions

- 17.8a** What is the effect of a stock split on stockholder wealth?
- 17.8b** How does the accounting treatment of a stock split differ from that used with a small stock dividend?

Summary and Conclusions

17.9

In this chapter, we first discussed the types of dividends and how they are paid. We then defined dividend policy and examined whether or not dividend policy matters. Next, we illustrated how a firm might establish a dividend policy and described an important alternative to cash dividends, a share repurchase.

In covering these subjects, we discussed the following points:

1. Dividend policy is irrelevant when there are no taxes or other imperfections because shareholders can effectively undo the firm's dividend strategy. Shareholders who receive dividends greater than desired can reinvest the excess. Conversely, shareholders who receive dividends smaller than desired can sell off extra shares of stock.

2. Individual shareholder income taxes and new issue flotation costs are real-world considerations that favor a low dividend payout. With taxes and new issue costs, the firm should pay out dividends only after all positive NPV projects have been fully financed.
3. There are groups in the economy that may favor a high payout. These include many large institutions such as pension plans. Recognizing that some groups prefer a high payout and some prefer a low payout, the clientele effect argument supports the idea that dividend policy responds to the needs of stockholders. For example, if 40 percent of the stockholders prefer low dividends and 60 percent of the stockholders prefer high dividends, approximately 40 percent of companies will have a low dividend payout, and 60 percent will have a high payout. This sharply reduces the impact of any individual firm's dividend policy on its market price.
4. A stock repurchase acts much like a cash dividend, but it has a significant tax advantage. Stock repurchases are therefore a very useful part of overall dividend policy.
5. We discussed recent research and thinking on dividend policy. We saw that dividends are heavily concentrated in a relatively small number of larger, older firms and that the use of share repurchases continues to grow. We described a simple life cycle theory of distributions in which firms trade off the agency costs of excess cash retention against the future costs of external equity financing. The implication is that younger firms with significant growth opportunities will not distribute cash, but older, profitable firms with significant free cash flow will distribute cash.

To close our discussion of dividends, we emphasize one last time the difference between dividends and dividend policy. Dividends are important because the value of a share of stock is ultimately determined by the dividends that will be paid. What is less clear is whether the time pattern of dividends (more now versus more later) matters. This is the dividend policy question, and it is not easy to give a definitive answer to it.

CONNECT TO FINANCE



Connect Finance offers you plenty of opportunities to practice mastering these concepts. Log on to connect.mheducation.com to learn more. If you like what you see, ask your professor about using *Connect Finance*!

Can you answer the following *Connect Quiz* questions?

- Section 17.1** Dividends are paid to the parties listed as shareholders on what date?
- Section 17.3** What factors favor a high dividend payout?
- Section 17.4** Which parties are most apt to prefer a low dividend payout?
- Section 17.8** Tomas currently owns 300 shares of Doo Little Corp. How many shares will he own if the firm does a four-for-five reverse stock split?

CONCEPTS REVIEW AND CRITICAL THINKING QUESTIONS

1. **Dividend Policy Irrelevance [LO2]** How is it possible that dividends are so important, but at the same time, dividend policy is irrelevant?
2. **Stock Repurchases [LO4]** What is the impact of a stock repurchase on a company's debt ratio? Does this suggest another use for excess cash?
3. **Dividend Chronology [LO1]** On Tuesday, December 5, Hometown Power Co.'s board of directors declares a dividend of 75 cents per share payable on Wednesday,

January 17, to shareholders of record as of Wednesday, January 3. When is the ex-dividend date? If a shareholder buys stock before that date, who gets the dividends on those shares, the buyer or the seller?

4. **Alternative Dividends [LO1]** Some corporations, like one British company that offers its large shareholders free crematorium use, pay dividends in kind (that is, offer their services to shareholders at below-market cost). Should mutual funds invest in stocks that pay these dividends in kind? (The fundholders do not receive these services.)
5. **Dividends and Stock Price [LO1]** If increases in dividends tend to be followed by (immediate) increases in share prices, how can it be said that dividend policy is irrelevant?
6. **Dividends and Stock Price [LO1]** Last month, Central Virginia Power Company, which had been having trouble with cost overruns on a nuclear power plant that it had been building, announced that it was “temporarily suspending payments due to the cash flow crunch associated with its investment program.” The company’s stock price dropped from \$28.50 to \$25 when this announcement was made. How would you interpret this change in the stock price (that is, what would you say caused it)?
7. **Dividend Reinvestment Plans [LO1]** The DRK Corporation has recently developed a dividend reinvestment plan, or DRIP. The plan allows investors to reinvest cash dividends automatically in DRK in exchange for new shares of stock. Over time, investors in DRK will be able to build their holdings by reinvesting dividends to purchase additional shares of the company.

A large number of companies offer dividend reinvestment plans. Most companies with DRIPs charge no brokerage or service fees. In fact, the shares of DRK will be purchased at a 10 percent discount from the market price.

A consultant for DRK estimates that about 75 percent of DRK’s shareholders will take part in this plan. This is somewhat higher than the average.

Evaluate DRK’s dividend reinvestment plan. Will it increase shareholder wealth? Discuss the advantages and disadvantages involved here.

8. **Dividend Policy [LO2]** For initial public offerings of common stock, 2017 was a slow year, with about \$24.53 billion raised by the process. Relatively few of the 108 firms involved paid cash dividends. Why do you think that most chose not to pay cash dividends?

Use the following information to answer the next two questions:

Historically, the U.S. tax code treated dividend payments made to shareholders as ordinary income. Thus, dividends were taxed at the investor’s marginal tax rate, which was as high as 38.6 percent in 2002. Capital gains were taxed at a capital gains tax rate, which was the same for most investors and fluctuated through the years. In 2002, the capital gains tax rate stood at 20 percent. In an effort to stimulate the economy, President George W. Bush presided over a tax plan overhaul that included changes in dividend and capital gains tax rates. The new tax plan, which was implemented in 2003, called for a 15 percent tax rate on both dividends and capital gains for investors in higher tax brackets. For lower-tax bracket investors, the tax rate on dividends and capital gains was set at 5 percent through 2007, dropping to zero in 2008.

9. **Ex-Dividend Stock Prices [LO1]** How do you think this tax law change affected ex-dividend stock prices?
10. **Stock Repurchases [LO4]** How do you think this tax law change affected the relative attractiveness of stock repurchases compared to dividend payments?

QUESTIONS AND PROBLEMS



BASIC

(Questions 1–9)

- Dividends and Taxes [LO2]** Ginger, Inc., has declared a \$5.35 per share dividend. Suppose capital gains are not taxed, but dividends are taxed at 15 percent. New IRS regulations require that taxes be withheld at the time the dividend is paid. The company's stock sells for \$74.20 per share, and the stock is about to go ex dividend. What do you think the ex-dividend price will be?
- Stock Dividends [LO3]** The owners' equity accounts for Vidi International are shown here:

Common stock (\$.50 par value)	\$ 25,000
Capital surplus	215,000
Retained earnings	642,700
Total owners' equity	<u><u>\$882,700</u></u>

- If the company's stock currently sells for \$32 per share and a 10 percent stock dividend is declared, how many new shares will be distributed? Show how the equity accounts would change.
- If the company declared a 25 percent stock dividend, how would the accounts change?
- Stock Splits [LO3]** For the company in Problem 2, show how the equity accounts will change if:
 - The company declares a four-for-one stock split. How many shares are outstanding now? What is the new par value per share?
 - The company declares a one-for-five reverse stock split. How many shares are outstanding now? What is the new par value per share?
- Stock Splits and Stock Dividends [LO3]** Simmons Mineral Operations, Inc. (SMO), currently has 530,000 shares of stock outstanding that sell for \$68 per share. Assuming no market imperfections or tax effects exist, what will the share price be after:
 - SMO has a five-for-three stock split?
 - SMO has a 15 percent stock dividend?
 - SMO has a 42.5 percent stock dividend?
 - SMO has a four-for-seven reverse stock split?
 Determine the new number of shares outstanding in parts (a) through (d).
- Regular Dividends [LO1]** The balance sheet for Sinking Ship Corp. is shown here in market value terms. There are 14,000 shares of stock outstanding.

Market Value Balance Sheet			
Cash	\$ 53,700	Equity	\$438,700
Fixed assets	<u>385,000</u>		
Total	<u><u>\$438,700</u></u>	Total	<u><u>\$438,700</u></u>

The company has declared a dividend of \$1.30 per share. The stock goes ex dividend tomorrow. Ignoring any tax effects, what is the stock selling for today? What will it sell for tomorrow? What will the balance sheet look like after the dividends are paid?

- Share Repurchase [LO4]** In Problem 5, suppose the company has announced it is going to repurchase \$18,200 worth of stock. What effect will this transaction have on the equity of the firm? How many shares will be outstanding? What will the price per

share be after the repurchase? Ignoring tax effects, show how the share repurchase is effectively the same as a cash dividend.

- 7. Stock Dividends [LO3]** The market value balance sheet for Bobaflex Manufacturing is shown here. The company has declared a 25 percent stock dividend. The stock goes ex dividend tomorrow (the chronology for a stock dividend is similar to that for a cash dividend). There are 12,000 shares of stock outstanding. What will the ex-dividend price be?

Market Value Balance Sheet			
Cash	\$ 79,000	Debt	\$116,000
Fixed assets	<u>545,000</u>	Equity	<u>508,000</u>
Total	<u><u>\$624,000</u></u>	Total	<u><u>\$624,000</u></u>

- 8. Stock Dividends [LO3]** The company with the common equity accounts shown here has declared a 15 percent stock dividend when the market value of its stock is \$53 per share. What effects will the distribution of the stock dividend have on the equity accounts?

Common stock (\$1 par value)	\$ 245,000
Capital surplus	618,000
Retained earnings	<u>2,758,300</u>
Total owners' equity	<u><u>\$3,621,300</u></u>

- 9. Stock Splits [LO3]** In Problem 8, suppose the company instead decides on a four-for-one stock split. The firm's 65-cent per-share cash dividend on the new (postsplit) shares represents an increase of 10 percent over last year's dividend on the presplit stock. What effect does this have on the equity accounts? What was last year's dividend per share?
- 10. Homemade Dividends [LO2]** You own 1,000 shares of stock in Avondale Corporation. You will receive a \$3.15 per share dividend in one year. In two years, the company will pay a liquidating dividend of \$57 per share. The required return on the company's stock is 15 percent. What is the current share price of your stock (ignoring taxes)? If you would rather have equal dividends in each of the next two years, show how you can accomplish this by creating homemade dividends. *Hint:* Dividends will be in the form of an annuity.
- 11. Homemade Dividends [LO2]** In Problem 10, suppose you want only \$1,500 total in dividends the first year. What will your homemade dividend be in two years?
- 12. Stock Repurchase [LO4]** Awake Corporation is evaluating an extra dividend versus a share repurchase. In either case, \$17,500 would be spent. Current earnings are \$1.89 per share, and the stock currently sells for \$64 per share. There are 2,000 shares outstanding. Ignore taxes and other imperfections in answering the first two questions.
- Evaluate the two alternatives in terms of the effect on the price per share of the stock and shareholder wealth.
 - What will be the effect on the company's EPS and PE ratio under the two different scenarios?
 - In the real world, which of these actions would you recommend? Why?

INTERMEDIATE
(Questions 10–12)



CHALLENGE

(Questions 13–16)

- 13. Expected Return, Dividends, and Taxes [LO2]** The Gecko Company and the Gordon Company are two firms that have the same business risk but different dividend policies. Gecko pays no dividend, whereas Gordon has an expected dividend yield of 2.9 percent. Suppose the capital gains tax rate is zero, whereas the income tax rate is 35 percent. Gecko has an expected earnings growth rate of 12 percent annually, and its stock price is expected to grow at this same rate. If the aftertax expected returns on the two stocks are equal (because they are in the same risk class), what is the pretax required return on Gordon's stock?

- 14. Dividends and Taxes [LO2]** As discussed in the text, in the absence of market imperfections and tax effects, we would expect the share price to decline by the amount of the dividend payment when the stock goes ex dividend. Once we consider the role of taxes, however, this is not necessarily true. One model has been proposed that incorporates tax effects into determining the ex-dividend price:⁹

$$(P_0 - P_x)/D = (1 - T_p)/(1 - T_G)$$

where P_0 is the price just before the stock goes ex, P_x is the ex-dividend share price, D is the amount of the dividend per share, T_p is the relevant marginal personal tax rate on dividends, and T_G is the effective marginal tax rate on capital gains.

- a. If $T_p = T_G = 0$, how much will the share price fall when the stock goes ex?
 - b. If $T_p = 15$ percent and $T_G = 0$, how much will the share price fall?
 - c. If $T_p = 15$ percent and $T_G = 30$ percent, how much will the share price fall?
 - d. Suppose the only owners of stock are corporations. Recall that corporations get at least a 50 percent exemption from taxation on the dividend income they receive, but they do not get such an exemption on capital gains. If the corporation's income and capital gains tax rates are both 35 percent, what does this model predict the ex-dividend share price will be?
 - e. What does this problem tell you about real-world tax considerations and the dividend policy of the firm?
- 15. Dividends versus Reinvestment [LO2]** National Business Machine Co. (NBM) has \$4 million of extra cash after taxes have been paid. NBM has two choices to make use of this cash. One alternative is to invest the cash in financial assets. The resulting investment income will be paid out as a special dividend at the end of three years. In this case, the firm can invest in Treasury bills yielding 2.5 percent or in 4.3 percent preferred stock. Assume IRS regulations allow the company to exclude from taxable income 70 percent of the dividends received from investing in another company's stock. Another alternative is to pay out the cash now as dividends. This would allow the shareholders to invest on their own in Treasury bills with the same yield, or in preferred stock. The corporate tax rate is 21 percent. Assume the investor has a 31 percent personal income tax rate, which is applied to interest income and preferred stock dividends. Also assume the personal dividend tax rate is 15 percent on common stock dividends. Should the cash be paid today or in three years? Which of the two options generates the highest aftertax income for the shareholders?
- 16. Dividends versus Reinvestment [LO2]** After completing its capital spending for the year, Carlson Manufacturing has \$1,000 extra cash. Carlson's managers must choose between investing the cash in Treasury bonds that yield 3 percent or paying the cash out to investors who would invest in the bonds themselves.

⁹N. Elton and M. Gruber, "Marginal Stockholder Tax Rates and the Clientele Effect," *Review of Economics and Statistics* 52 (February 1970).

- a. If the corporate tax rate is 35 percent, what personal tax rate would make the investors equally willing to receive the dividend or to let Carlson invest the money?
- b. Is the answer to (a) reasonable? Why or why not?
- c. Suppose the only investment choice is preferred stock that yields 6 percent. The corporate dividend exclusion of 70 percent applies. What personal tax rate will make the stockholders indifferent to the outcome of Carlson's dividend decision?
- d. Is this a compelling argument for a low dividend payout ratio? Why or why not?

MINICASE

Electronic Timing, Inc.

Electronic Timing, Inc. (ETI), is a small company founded 15 years ago by electronics engineers Tom Miller and Jessica Kerr. ETI manufactures integrated circuits to capitalize on the complex mixed-signal design technology and has recently entered the market for frequency timing generators, or silicon timing devices, which provide the timing signals or “clocks” necessary to synchronize electronic systems. Its clock products originally were used in PC video graphics applications, but the market has subsequently expanded to include motherboards, PC peripheral devices, and other digital consumer electronics, such as digital television boxes and game consoles. ETI also designs and markets custom application-specific integrated circuits (ASICs) for industrial customers. The ASIC's design combines analog and digital, or mixed-signal, technology. In addition to Tom and Jessica, Nolan Pittman, who provided capital for the company, is the third primary owner. Each owns 25 percent of the 1 million shares outstanding. The company has several other individuals, including current employees, who own the remaining shares.

Recently, the company designed a new computer motherboard. The company's design is both more efficient and less expensive to manufacture, and the ETI design is expected to become standard in many personal computers. After investigating the possibility of manufacturing the new motherboard, ETI determined that the costs involved in building a new plant would be prohibitive. The owners also decided that they were unwilling to bring in another large outside owner. Instead, ETI sold the design to an outside firm. The sale of the motherboard design was completed for an aftertax payment of \$30 million.

QUESTIONS

1. Tom believes the company should use the extra cash to pay a special one-time dividend. How will this proposal

affect the stock price? How will it affect the value of the company?

2. Jessica believes the company should use the extra cash to pay off debt and upgrade and expand its existing manufacturing capability. How would Jessica's proposals affect the company?
3. Nolan favors a share repurchase. He argues that a repurchase will increase the company's PE ratio, return on assets, and return on equity. Are his arguments correct? How will a share repurchase affect the value of the company?
4. Another option discussed by Tom, Jessica, and Nolan would be to begin a regular dividend payment to shareholders. How would you evaluate this proposal?
5. One way to value a share of stock is the dividend growth, or growing perpetuity, model. Consider the following: The dividend payout ratio is 1 minus b , where b is the “retention” or “plowback” ratio. So, the dividend next year will be the earnings next year, E_1 , times 1 minus the retention ratio. The most commonly used equation to calculate the sustainable growth rate is the return on equity times the retention ratio. Substituting these relationships into the dividend growth model, we get the following equation to calculate the price of a share of stock today:

$$P_0 = \frac{E_1(1 - b)}{R_s - \text{ROE} \times b}$$

What are the implications of this result in terms of whether the company should pay a dividend or upgrade and expand its manufacturing capability? Explain.

6. Does the question of whether the company should pay a dividend depend on whether the company is organized as a corporation or an LLC?

18 | Short-Term Finance and Planning

IN EARLY 2017, car sales were slowing and inventories were climbing. For example, the Buick LaCrosse sat on dealers' lots for an average of 168 days before being sold. At the same time, sales of the Chevrolet Spark were not exactly electrifying, either, as it took 170 days for each of those cars to be sold. In the auto industry, high inventory creates problems, and those problems are often resolved by offering large incentives. For example, Jeep, which had 138 days of inventory of its Renegade, offered \$2,500 to entice new buyers. At the other end of the spectrum, it took only 38 days on average to sell a new Honda Pilot.

As this chapter explores, the amount of time goods are carried in inventory until they are sold is an important element of short-term financial management. Industries such as automobile manufacturing pay close attention to it.

Learning Objectives

After studying this chapter, you should be able to:

- L01** Describe the operating and cash cycles and why they are important.
- L02** List the different types of short-term financial policy.
- L03** Summarize the essentials of short-term financial planning.
- L04** Explain the sources and uses of cash on the balance sheet.

©by_adri/iStockPhoto/GettyImages

For updates on the latest happenings in finance, visit fundamentals-of-corporate-finance.blogspot.com.

To this point, we have described many of the decisions of long-term finance, such as those of capital budgeting, dividend policy, and financial structure. In this chapter, we begin to discuss short-term finance. Short-term finance is primarily concerned with the analysis of decisions that affect current assets and current liabilities.

Frequently, the term *net working capital* is associated with short-term financial decision making. As we describe in Chapter 2 and elsewhere, net working capital is the difference between current assets and current liabilities. Often, short-term financial management is called *working capital management*. These terms mean the same thing.

There is no universally accepted definition of *short-term finance*. The most important difference between short-term and long-term finance is in the timing of cash flows. Short-term financial decisions typically involve cash inflows and outflows that occur within a year or less. For example, short-term financial decisions are involved when a firm orders raw materials, pays in cash, and anticipates selling finished goods in one year for cash. In contrast, long-term financial decisions are involved when a firm purchases a special machine that will reduce operating costs over, say, the next five years.



What types of questions fall under the general heading of short-term finance? To name a few:

1. What is a reasonable level of cash to keep on hand (in a bank) to pay bills?
2. How much should the firm borrow in the short term?
3. How much credit should be extended to customers?

This chapter introduces the basic elements of short-term financial decisions. First, we discuss the short-term operating activities of the firm. We then identify some alternative short-term financial policies. Finally, we outline the basic elements in a short-term financial plan and describe short-term financing instruments.

Tracing Cash and Net Working Capital

In this section, we examine the components of cash and net working capital as they change from one year to the next. We have already discussed various aspects of this subject in Chapters 2, 3, and 4. We briefly review some of that discussion as it relates to short-term financing decisions. Our goal is to describe the short-term operating activities of the firm and their impact on cash and working capital.

To begin, recall that *current assets* are cash and other assets that are expected to convert to cash within the year. Current assets are presented on the balance sheet in order of their accounting liquidity—that is, the ease with which they can be converted to cash and the time it takes to convert them. Four of the most important items found in the current assets section of a balance sheet are cash and cash equivalents, marketable securities, accounts receivable, and inventories.

Analogous to their investment in current assets, firms use several kinds of short-term debt, called *current liabilities*. Current liabilities are obligations that are expected to require cash payment within one year (or within the operating period if it is longer than one year). Three major items classified as current liabilities are accounts payable, expenses payable (including accrued wages and taxes), and notes payable.

Because we want to focus on changes in cash, we start off by defining *cash* in terms of the other elements of the balance sheet. This lets us isolate the cash account and explore how cash is impacted by the firm's operating and financing decisions. The basic balance sheet identity can be written as:

$$\text{Net working capital} + \text{Fixed assets} = \text{Long-term debt} + \text{Equity}$$

18.1



Interested in a career in short-term finance? Visit the Treasury Management International website at www.treasury-management.com.

Net working capital is cash plus other current assets, less current liabilities—that is:

$$\text{Net working capital} = (\text{Cash} + \text{Other current assets}) - \text{Current liabilities}$$

18.1



If we substitute this for net working capital in the basic balance sheet identity and rearrange things a bit, we see that cash is:

$$\begin{aligned}\text{Cash} &= \text{Long-term debt} + \text{Equity} + \text{Current liabilities} \\ &\quad - \text{Current assets other than cash} - \text{Fixed assets}\end{aligned}$$

18.2



This tells us in general terms that some activities naturally increase cash and some activities decrease it. We can list these various activities, along with an example of each, as follows:

ACTIVITIES THAT INCREASE CASH

Increasing long-term debt (borrowing over the long term)

Increasing equity (selling some stock)

18.3



- Increasing current liabilities (getting a 90-day loan)
- Decreasing current assets other than cash (selling some inventory for cash)
- Decreasing fixed assets (selling some property)

ACTIVITIES THAT DECREASE CASH

- Decreasing long-term debt (paying off a long-term debt)
- Decreasing equity (repurchasing some stock)
- Decreasing current liabilities (paying off a 90-day loan)
- Increasing current assets other than cash (buying some inventory for cash)
- Increasing fixed assets (buying some property)

Notice that our two lists are exact opposites. For example, floating a long-term bond issue increases cash (at least until the money is spent). Paying off a long-term bond issue decreases cash.

As we discussed in Chapter 3, those activities that increase cash are called *sources of cash*. Those activities that decrease cash are called *uses of cash*. Looking back at our list, we see that sources of cash always involve increasing a liability (or equity) account or decreasing an asset account. This makes sense because increasing a liability means that we have raised money by borrowing it or by selling an ownership interest in the firm. A decrease in an asset means that we have sold or otherwise liquidated an asset. In either case, there is a cash inflow.

Uses of cash are just the reverse. A use of cash involves decreasing a liability by paying it off, perhaps, or increasing assets by purchasing something. Both of these activities require that the firm spend some cash.

EXAMPLE 18.1

Sources and Uses

Here is a quick check of your understanding of sources and uses: If accounts payable go up by \$100, does this indicate a source or a use? What if accounts receivable go up by \$100?

Accounts payable are what we owe our suppliers. This is a short-term debt. If it rises by \$100, we have effectively borrowed the money, which is a *source of cash*. Receivables are what our customers owe to us, so an increase of \$100 in accounts receivable means that we have lent the money; this is a *use of cash*.

Concept Questions

- 18.1a** What is the difference between net working capital and cash?
- 18.1b** Will net working capital always increase when cash increases?
- 18.1c** List five potential sources of cash.
- 18.1d** List five potential uses of cash.

18.2 The Operating Cycle and the Cash Cycle

The primary concern in short-term finance is the firm's short-run operating and financing activities. For a typical manufacturing firm, these short-run activities might consist of the following sequence of events and decisions:

Event	Decision
1. Buying raw materials	1. How much inventory to order
2. Paying cash	2. Whether to borrow or draw down cash balances
3. Manufacturing the product	3. What choice of production technology to use
4. Selling the product	4. Whether credit should be extended to a particular customer
5. Collecting cash	5. How to collect

These activities create patterns of cash inflows and cash outflows. These cash flows are both unsynchronized and uncertain. They are unsynchronized because, for example, the payment of cash for raw materials does not happen at the same time as the receipt of cash from selling the product. They are uncertain because future sales and costs cannot be precisely predicted.

DEFINING THE OPERATING AND CASH CYCLES

We can start with a simple case. One day, call it Day 0, we purchase \$1,000 worth of inventory on credit. We pay the bill 30 days later; and after 30 more days, someone buys the \$1,000 in inventory for \$1,400. Our buyer does not actually pay for another 45 days. We can summarize these events chronologically as follows:

Day	Activity	Cash Effect
0	Acquire inventory	None
30	Pay for inventory	-\$1,000
60	Sell inventory on credit	None
105	Collect on sale	+\$1,400

The Operating Cycle There are several things to notice in our example. First, the entire cycle, from the time we acquire some inventory to the time we collect the cash, takes 105 days. This is called the **operating cycle**.

As we illustrate, the operating cycle is the length of time it takes to acquire inventory, sell it, and collect for it. This cycle has two distinct components. The first part is the time it takes to acquire and sell the inventory. This period, a 60-day span in our example, is called the **inventory period**. The second part is the time it takes to collect on the sale, 45 days in our example. This is called the **accounts receivable period**.

Based on our definitions, the operating cycle is obviously just the sum of the inventory and accounts receivable periods:

$$\text{Operating cycle} = \text{Inventory period} + \text{Accounts receivable period}$$

$$105 \text{ days} = 60 \text{ days} + 45 \text{ days}$$

What the operating cycle describes is how a product moves through the current asset accounts. The product begins life as inventory, is converted to a receivable when it is sold, and is finally converted to cash when we collect from the sale. Notice that, at each step, the asset is moving closer to cash.

The Cash Cycle The second thing to notice is that the cash flows and other events that occur are not synchronized. For example, we don't actually pay for the inventory until 30 days after we acquire it. The intervening 30-day period is called the **accounts payable period**. Next, we spend cash on Day 30, but we don't collect until Day 105. Somehow, we have to arrange to finance the \$1,000 for $105 - 30 = 75$ days. This period is called the **cash cycle**.

operating cycle

The period between the acquisition of inventory and the collection of cash from receivables.

inventory period

The time it takes to acquire and sell inventory.

accounts receivable period

The time between sale of inventory and collection of the receivable.

18.4

accounts payable period

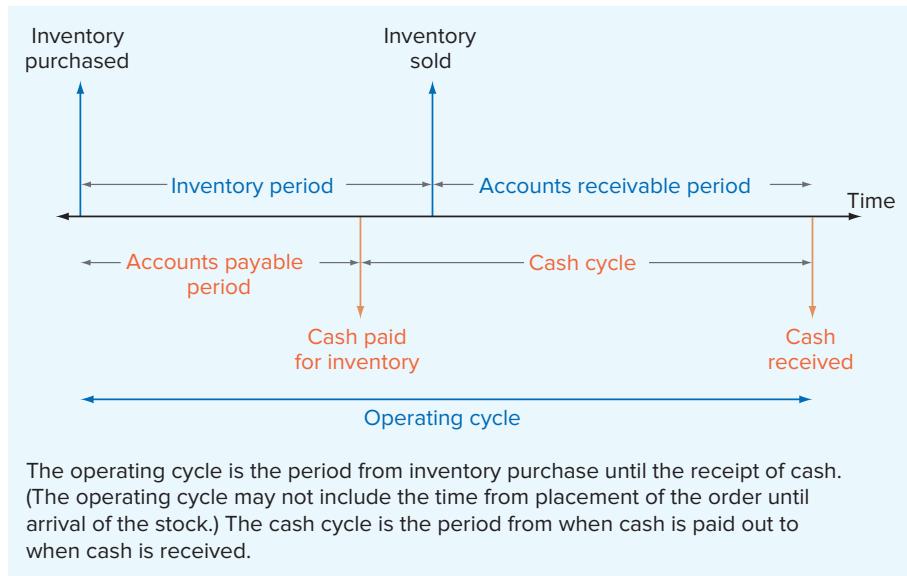
The time between receipt of inventory and payment for it.

cash cycle

The time between cash disbursement and cash collection.

FIGURE 18.1

Cash Flow Time Line and the Short-Term Operating Activities of a Typical Manufacturing Firm



The cash cycle is the number of days that pass before we collect the cash from a sale, measured from when we actually pay for the inventory. Notice that, based on our definitions, the cash cycle is the difference between the operating cycle and the accounts payable period:

$$\text{Cash cycle} = \text{Operating cycle} - \text{Accounts payable period}$$

$$75 \text{ days} = 105 \text{ days} - 30 \text{ days}$$

18.5

cash flow time line

A graphical representation of the operating cycle and the cash cycle.

Figure 18.1 depicts the short-term operating activities and cash flows for a typical manufacturing firm by way of a cash flow time line. As shown, the **cash flow time line** presents the operating cycle and the cash cycle in graphical form. In Figure 18.1, the need for short-term financial management is suggested by the gap between the cash inflows and the cash outflows. This is related to the lengths of the operating cycle and the accounts payable period.

The gap between short-term inflows and outflows can be filled either by borrowing or by holding a liquidity reserve in the form of cash or marketable securities. Alternatively, the gap can be shortened by changing the inventory, receivable, and payable periods. These are all managerial options that we discuss in the following sections and in subsequent chapters.

Internet-based bookseller and retailer Amazon.com provides an interesting example of the importance of managing the cash cycle. By early 2017, the market value of Amazon was higher than (in fact more than 500 times as much as) that of Barnes & Noble, king of the brick-and-mortar bookstores.

How could Amazon be worth so much more? There are multiple reasons, but short-term financial management is one factor. During 2016, Amazon turned over its inventory about 8 times per year, twice as fast as Barnes & Noble; so its inventory period was dramatically shorter. Amazon's receivables period is 21 days, but due in part to the company's bargaining power with suppliers, its payables period is almost 135 days. This means Amazon has a *negative cash cycle*! In fact, during 2016, Amazon's cash cycle was negative 69 days. Every sale generates a cash inflow that can be put to work immediately.

Title of Manager	Duties Related to Short-Term Financial Management	Assets/Liabilities Influenced
Cash manager	Collection, concentration, disbursement; short-term investments; short-term borrowing; banking relations	Cash, marketable securities, short-term loans
Credit manager	Monitoring and control of accounts receivable; credit policy decisions	Accounts receivable
Marketing manager	Credit policy decisions	Accounts receivable
Purchasing manager	Decisions about purchases, suppliers; may negotiate payment terms	Inventory, accounts payable
Production manager	Setting of production schedules and materials requirements	Inventory, accounts payable
Payables manager	Decisions about payment policies and about whether to take discounts	Accounts payable
Controller	Accounting information about cash flows; reconciliation of accounts payable; application of payments to accounts receivable	Accounts receivable, accounts payable

TABLE 18.1
Managers Who Deal with Short-Term Financial Problems

THE OPERATING CYCLE AND THE FIRM'S ORGANIZATIONAL CHART

Before we examine the operating and cash cycles in greater detail, it is useful for us to take a look at the people involved in managing a firm's current assets and liabilities. As Table 18.1 illustrates, short-term financial management in a large corporation involves a number of different financial and nonfinancial managers. Examining Table 18.1, we see that selling on credit involves at least three different entities: The credit manager, the marketing manager, and the controller. Of these three, only two are responsible to the vice president of finance (the marketing function is usually associated with the vice president of marketing). There is the potential for conflict, particularly if different managers concentrate on only part of the picture. For example, if marketing is trying to land a new account, it may seek more liberal credit terms as an inducement. This may increase the firm's investment in receivables or its exposure to bad-debt risk, and conflict can result.

CALCULATING THE OPERATING AND CASH CYCLES

In our example, the lengths of time that made up the different periods were obvious. If all we have is financial statement information, we will have to do a little more work. We illustrate these calculations next.

To begin, we need to determine various things such as how long it takes, on average, to sell inventory and how long it takes, on average, to collect payment. We start by gathering some balance sheet information such as the following (in thousands):

Item	Beginning	Ending	Average
Inventory	\$2,000	\$3,000	\$2,500
Accounts receivable	1,600	2,000	1,800
Accounts payable	750	1,000	875

Also, from the most recent income statement, we might have the following figures (in thousands):

Net sales	\$11,500
Cost of goods sold	8,200

We now need to calculate some financial ratios. We discussed these in some detail in Chapter 3; here, we define them and use them as needed.

The Operating Cycle First of all, we need the inventory period. We spent \$8.2 million on inventory (our cost of goods sold). Our average inventory was \$2.5 million. We turned our inventory over \$8.2/\$2.5 times during the year:¹

$$\begin{aligned}\text{Inventory turnover} &= \frac{\text{Cost of goods sold}}{\text{Average inventory}} \\ &= \frac{\$8.2 \text{ million}}{\$2.5 \text{ million}} = 3.28 \text{ times}\end{aligned}$$

Loosely speaking, this tells us that we bought and sold off our inventory 3.28 times during the year. This means that, on average, we held our inventory for:

$$\begin{aligned}\text{Inventory period} &= \frac{365 \text{ days}}{\text{Inventory turnover}} \\ &= \frac{365}{3.28} = 111 \text{ days}\end{aligned}$$

So, the inventory period is about 111 days. In other words, on average, inventory sat for about 111 days before it was sold.²

Similarly, receivables averaged \$1.8 million, and sales were \$11.5 million. Assuming that all sales were credit sales, the receivables turnover is:³

$$\begin{aligned}\text{Receivables turnover} &= \frac{\text{Credit sales}}{\text{Average accounts receivable}} \\ &= \frac{\$11.5 \text{ million}}{\$1.8 \text{ million}} = 6.39 \text{ times}\end{aligned}$$

If we turn over our receivables 6.39 times, then the receivables period is:

$$\begin{aligned}\text{Receivables period} &= \frac{365 \text{ days}}{\text{Receivables turnover}} \\ &= \frac{365}{6.39} = 57 \text{ days}\end{aligned}$$

The receivables period is also called the *days' sales in receivables* or the *average collection period*. Whatever it is called, it tells us that our customers took an average of 57 days to pay.

The operating cycle is the sum of the inventory and receivables periods:

$$\begin{aligned}\text{Operating cycle} &= \text{Inventory period} + \text{Accounts receivable period} \\ &= 111 \text{ days} + 57 \text{ days} = 168 \text{ days}\end{aligned}$$

This tells us that, on average, 168 days elapse between the time we acquire inventory and, having sold it, the time we collect for the sale.

¹Notice that in calculating inventory turnover here, we use the *average* inventory instead of using the ending inventory as we did in Chapter 3. Both approaches are used in the real world. To gain some practice using average figures, we will stick with this approach in calculating various ratios throughout this chapter.

²This measure is conceptually identical to the days' sales in inventory figure we discussed in Chapter 3.

³If fewer than 100 percent of our sales were credit sales, then we would just need a little more information—namely, credit sales for the year. See Chapter 3 for more discussion of this measure.

The Cash Cycle We now need the payables period. From the information given earlier, we know that average payables were \$875,000 and cost of goods sold was \$8.2 million. Our payables turnover is:

$$\begin{aligned}\text{Payables turnover} &= \frac{\text{Cost of goods sold}}{\text{Average payables}} \\ &= \frac{\$8.2 \text{ million}}{\$.875 \text{ million}} = 9.37 \text{ times}\end{aligned}$$

The payables period is:

$$\begin{aligned}\text{Payables period} &= \frac{365 \text{ days}}{\text{Payables turnover}} \\ &= \frac{365}{9.37} = 39 \text{ days}\end{aligned}$$

We took an average of 39 days to pay our bills.

Finally, the cash cycle is the difference between the operating cycle and the payables period:

$$\begin{aligned}\text{Cash cycle} &= \text{Operating cycle} - \text{Accounts payable period} \\ &= 168 \text{ days} - 39 \text{ days} = 129 \text{ days}\end{aligned}$$

So, on average, there is a 129-day delay between the time we pay for merchandise and the time we collect on the sale.

The Operating and Cash Cycles

EXAMPLE 18.2

You have collected the following information for the Slowpay Company:

Item	Beginning	Ending
Inventory	\$5,000	\$7,000
Accounts receivable	1,600	2,400
Accounts payable	2,700	4,800

Credit sales for the year just ended were \$50,000, and cost of goods sold was \$30,000. How long does it take Slowpay to collect on its receivables? How long does merchandise stay around before it is sold? How long does Slowpay take to pay its bills?

We can first calculate the three turnover ratios:

$$\text{Inventory turnover} = \$30,000/\$6,000 = 5 \text{ times}$$

$$\text{Receivables turnover} = \$50,000/\$2,000 = 25 \text{ times}$$

$$\text{Payables turnover} = \$30,000/\$3,750 = 8 \text{ times}$$

We use these to get the various periods:

$$\text{Inventory period} = 365/5 = 73 \text{ days}$$

$$\text{Receivables period} = 365/25 = 14.6 \text{ days}$$

$$\text{Payables period} = 365/8 = 45.6 \text{ days}$$

All told, Slowpay collects on a sale in 14.6 days, inventory sits around for 73 days, and bills get paid after about 46 days. The operating cycle here is the sum of the inventory and receivables periods: $73 + 14.6 = 87.6$ days. The cash cycle is the difference between the operating cycle and the payables period: $87.6 - 45.6 = 42$ days.

INTERPRETING THE CASH CYCLE

Our examples show that the cash cycle depends on the inventory, receivables, and payables periods. The cash cycle increases as the inventory and receivables periods get longer. It decreases if the company can defer payment of payables and thereby lengthen the payables period.

Unlike Amazon.com, most firms have a positive cash cycle, and they require financing for inventories and receivables. The longer the cash cycle, the more financing is required. Also, changes in the firm's cash cycle are often monitored as an early-warning measure. A lengthening cycle can indicate that the firm is having trouble moving inventory or collecting on its receivables. Such problems can be masked, at least partially, by an increased payables cycle; so both cycles should be monitored.

The link between the firm's cash cycle and its profitability can be easily seen by recalling that one of the basic determinants of profitability and growth for a firm is its total asset turnover, which is defined as Sales/Total assets. In Chapter 3, we saw that the higher this ratio is, the greater is the firm's accounting return on assets, ROA, and return on equity, ROE. Thus, all other things being the same, the shorter the cash cycle, the lower is the firm's investment in inventories and receivables. As a result, the firm's total assets are lower, and total asset turnover is higher.

Concept Questions

- 18.2a** Describe the operating cycle and the cash cycle. What are the differences?
- 18.2b** What does it mean to say that a firm has an inventory turnover ratio of 4?
- 18.2c** Explain the connection between a firm's accounting-based profitability and its cash cycle.

18.3 Some Aspects of Short-Term Financial Policy

The short-term financial policy that a firm adopts will be reflected in at least two ways:

1. *The size of the firm's investment in current assets:* This is usually measured relative to the firm's level of total operating revenues. A *flexible*, or accommodative, short-term financial policy would maintain a relatively high ratio of current assets to sales. A *restrictive* short-term financial policy would entail a low ratio of current assets to sales.⁴
2. *The financing of current assets:* This is measured as the proportion of short-term debt (that is, current liabilities) and long-term debt used to finance current assets. A restrictive short-term financial policy means a high proportion of short-term debt relative to long-term financing, and a flexible policy means less short-term debt and more long-term debt.

If we take these two areas together, we see that a firm with a flexible policy would have a relatively large investment in current assets, and it would finance this investment with

⁴Some people use the term *conservative* in place of *flexible* and the term *aggressive* in place of *restrictive*.

relatively less short-term debt. The net effect of a flexible policy is a relatively high level of net working capital. Put another way, with a flexible policy, the firm maintains a higher overall level of liquidity.

THE SIZE OF THE FIRM'S INVESTMENT IN CURRENT ASSETS

Short-term financial policies that are flexible with regard to current assets include such actions as:

1. Keeping large balances of cash and marketable securities.
2. Making large investments in inventory.
3. Granting liberal credit terms, which results in a high level of accounts receivable.

Restrictive short-term financial policies would be just the opposite:

1. Keeping low cash balances and making little investment in marketable securities.
2. Making small investments in inventory.
3. Allowing few or no credit sales, thereby minimizing accounts receivable.

Determining the optimal level of investment in short-term assets requires identification of the different costs of alternative short-term financing policies. The objective is to trade off the cost of a restrictive policy against the cost of a flexible one to arrive at the best compromise.

Current asset holdings are highest with a flexible short-term financial policy and lowest with a restrictive policy. So, flexible short-term financial policies are costly in that they require a greater investment in cash and marketable securities, inventory, and accounts receivable. We expect that future cash inflows will be higher with a flexible policy. For example, sales are stimulated by the use of a credit policy that provides liberal financing to customers. A large amount of finished inventory on hand ("on the shelf") enables quick delivery service to customers and may increase sales. Similarly, a large inventory of raw materials may result in fewer production stoppages because of inventory shortages.

A more restrictive short-term financial policy probably reduces future sales to levels below those that would be achieved under flexible policies. It is also possible that higher prices can be charged to customers under flexible working capital policies. Customers may be willing to pay higher prices for the quick delivery service and more liberal credit terms implicit in flexible policies.

Managing current assets can be thought of as involving a trade-off between costs that rise and costs that fall with the level of investment. Costs that rise with increases in the level of investment in current assets are called **carrying costs**. The larger the investment a firm makes in its current assets, the higher its carrying costs will be. Costs that fall with increases in the level of investment in current assets are called **shortage costs**.

In a general sense, carrying costs are the opportunity costs associated with current assets. The rate of return on current assets is very low when compared to that on other assets. For example, the rate of return on U.S. Treasury bills averages about 3 to 4 percent. This is very low compared to the rate of return firms would like to achieve overall. (U.S. Treasury bills are an important component of cash and marketable securities.)

Shortage costs are incurred when the investment in current assets is low. If a firm runs out of cash, it will be forced to sell marketable securities. Of course, if a firm runs out of cash and cannot readily sell marketable securities, it may have to borrow or default on an obligation. This situation is called a *cash-out*. A firm may lose customers if it runs out of inventory (a *stockout*) or if it cannot extend credit to customers.

carrying costs

Costs that rise with increases in the level of investment in current assets.

shortage costs

Costs that fall with increases in the level of investment in current assets.

More generally, there are two kinds of shortage costs:

1. *Trading, or order, costs*: Order costs are the costs of placing an order for more cash (brokerage costs, for example) or more inventory (production setup costs, for example).
2. *Costs related to lack of safety reserves*: These are costs of lost sales, lost customer goodwill, and disruption of production schedules.

The top part of Figure 18.2 illustrates the basic trade-off between carrying costs and shortage costs. On the vertical axis, we have costs measured in dollars; on the horizontal axis, we have the amount of current assets. Carrying costs start out at zero when current assets are zero and then climb steadily as current assets grow. Shortage costs start out very high and then decline as we add current assets. The total cost of holding current assets is the sum of the two. Notice how the combined costs reach a minimum at CA^* . This is the optimal level of current assets.

Optimal current asset holdings are highest under a flexible policy. This policy is one in which the carrying costs are perceived to be low relative to shortage costs. This is Case A in Figure 18.2. In comparison, under restrictive current asset policies, carrying costs are perceived to be high relative to shortage costs, resulting in lower current asset holdings. This is Case B in Figure 18.2.

ALTERNATIVE FINANCING POLICIES FOR CURRENT ASSETS

In previous sections, we looked at the basic determinants of the level of investment in current assets, and we focused on the asset side of the balance sheet. Now we turn to the financing side of the question. Here we are concerned with the relative amounts of short-term and long-term debt, assuming that the investment in current assets is constant.

An Ideal Case We start off with the simplest possible case: An “ideal” economy. In such an economy, short-term assets can always be financed with short-term debt, and long-term assets can be financed with long-term debt and equity. In this economy, net working capital is always zero.

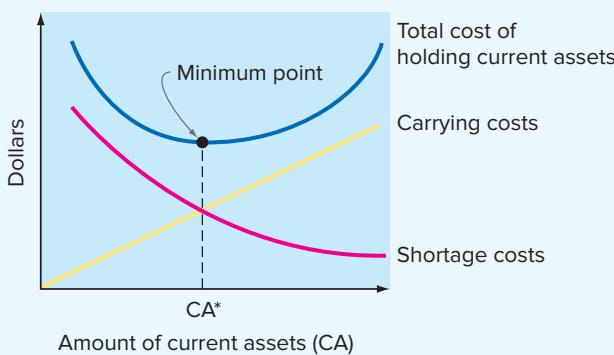
Consider a simplified case for a grain elevator operator. Grain elevator operators buy crops after harvest, store them, and sell them during the year. They have high inventories of grain after the harvest and end up with low inventories just before the next harvest.

Bank loans with maturities of less than one year are used to finance the purchase of grain and the storage costs. These loans are paid off from the proceeds of the sale of grain.

The situation is shown in Figure 18.3. Long-term assets are assumed to grow over time, whereas current assets increase at the end of the harvest and then decline during the year. Short-term assets end up at zero just before the next harvest. Current (short-term) assets are financed by short-term debt, and long-term assets are financed with long-term debt and equity. Net working capital—current assets minus current liabilities—is always zero. Figure 18.3 displays a “sawtooth” pattern that we will see again when we get to our discussion of cash management in the next chapter. For now, we need to discuss some alternative policies for financing current assets under less idealized conditions.

Different Policies for Financing Current Assets In the real world, it is not likely that current assets will ever drop to zero. For example, a long-term rising level of sales will result in some permanent investment in current assets. Moreover, the firm’s investments in long-term assets may show a great deal of variation.

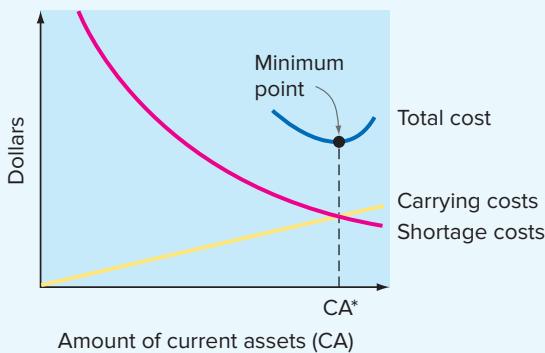
A growing firm can be thought of as having a total asset requirement consisting of the current assets and long-term assets needed to run the business efficiently. The total

Short-term financial policy: the optimal investment in current assets

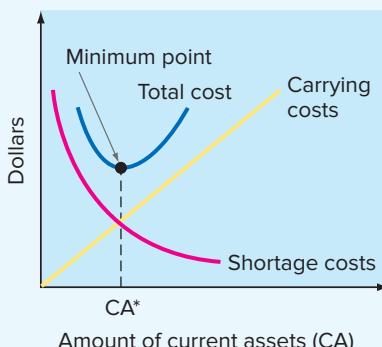
CA^* represents the optimal amount of current assets.
Holding this amount minimizes total costs.

Carrying costs increase with the level of investment in current assets. They include the costs of maintaining economic value and opportunity costs.

Shortage costs decrease with increases in the level of investment in current assets. They include trading costs and the costs related to being short of the current asset (for example, being short of cash). The firm's policy can be characterized as flexible or restrictive.

A. Flexible policy

A flexible policy is most appropriate when carrying costs are low relative to shortage costs.

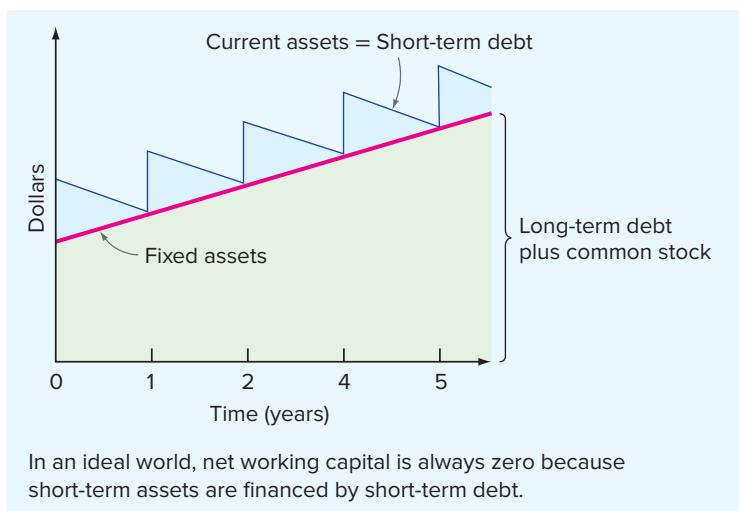
B. Restrictive policy

A restrictive policy is most appropriate when carrying costs are high relative to shortage costs.

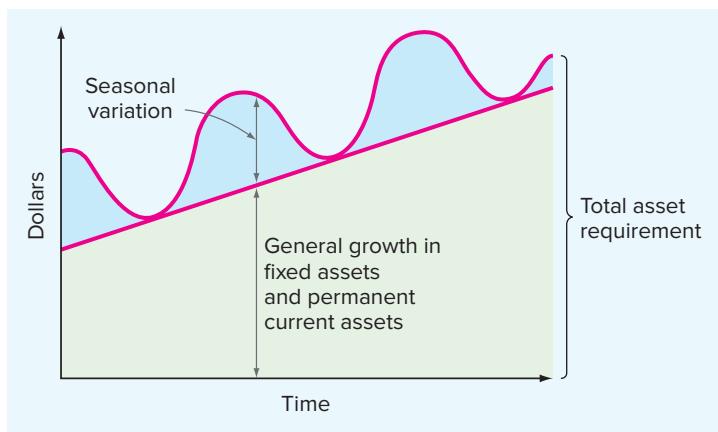
FIGURE 18.2**Carrying Costs and Shortage Costs**

FIGURE 18.3

Financing Policy for an Ideal Economy

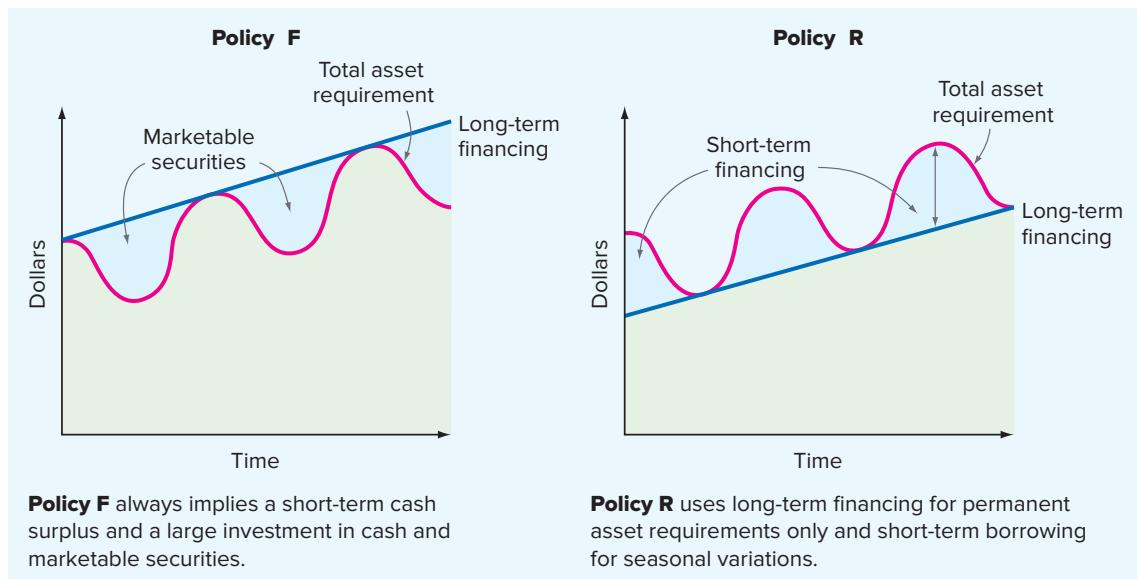
**FIGURE 18.4**

The Total Asset Requirement over Time



asset requirement may exhibit change over time for many reasons, including (1) a general growth trend, (2) seasonal variation around the trend, and (3) unpredictable day-to-day and month-to-month fluctuations. This fluctuation is depicted in Figure 18.4. (We have not tried to show the unpredictable day-to-day and month-to-month variations in the total asset requirement.)

The peaks and valleys in Figure 18.4 represent the firm's total asset needs through time. For example, for a lawn and garden supply firm, the peaks might represent inventory buildups prior to the spring selling season. The valleys would come about because of lower off-season inventories. Such a firm might consider two strategies to meet its cyclical needs. First, the firm could keep a relatively large pool of marketable securities. As the need for inventory and other current assets begins to rise, the firm could sell off marketable securities and use the cash to purchase whatever is needed. Once the inventory is sold and inventory holdings begin to decline, the firm could reinvest in marketable securities. This approach is the flexible policy illustrated in Figure 18.5 as Policy F. Notice that the firm essentially uses a pool of marketable securities as a buffer against changing current asset needs.

FIGURE 18.5 Alternative Asset Financing Policies

At the other extreme, the firm could keep relatively little in marketable securities. As the need for inventory and other assets begins to rise, the firm could borrow the needed cash on a short-term basis. The firm could repay the loans as the need for assets cycles back down. This approach is the restrictive policy illustrated in Figure 18.5 as Policy R.

In comparing the two strategies illustrated in Figure 18.5, notice that the chief difference is the way in which the seasonal variation in asset needs is financed. In the flexible case, the firm finances internally, using its own cash and marketable securities. In the restrictive case, the firm finances the variation externally, borrowing the needed funds on a short-term basis. As we discussed previously, all else being the same, a firm with a flexible policy will have a greater investment in net working capital.

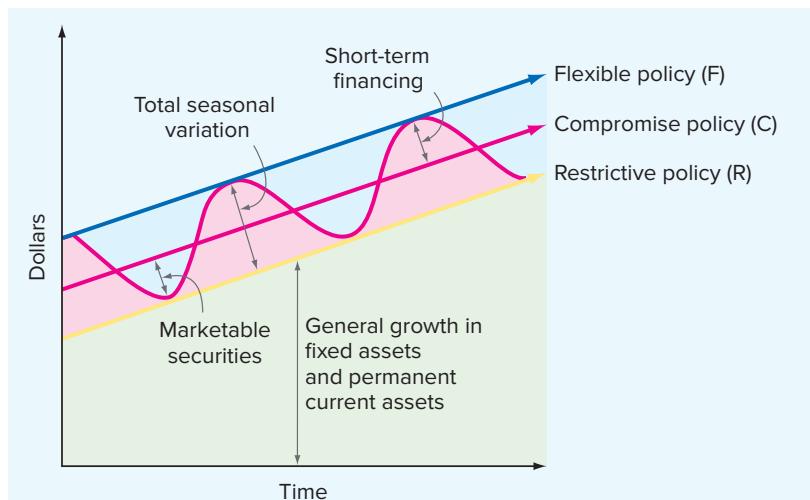
WHICH FINANCING POLICY IS BEST?

What is the most appropriate amount of short-term borrowing? There is no definitive answer. Several considerations must be included in a proper analysis:

1. *Cash reserves:* The flexible financing policy implies surplus cash and little short-term borrowing. This policy reduces the probability that a firm will experience financial distress. Firms may not have to worry as much about meeting recurring, short-run obligations. However, investments in cash and marketable securities are zero net present value investments at best.
2. *Maturity hedging:* Most firms attempt to match the maturities of assets and liabilities. They finance inventories with short-term bank loans and fixed assets with long-term financing. Firms tend to avoid financing long-lived assets with short-term borrowing. This type of maturity mismatching would necessitate frequent refinancing and is inherently risky because short-term interest rates are more volatile than longer-term rates.
3. *Relative interest rates:* Short-term interest rates are usually lower than long-term rates. This implies that it is, on average, more costly to rely on long-term borrowing as compared to short-term borrowing.

FIGURE 18.6

A Compromise
Financing Policy



With a compromise policy, the firm keeps a reserve of liquidity that it uses to initially finance seasonal variations in current asset needs. Short-term borrowing is used when the reserve is exhausted.

The two policies depicted in Figure 18.5 are, of course, extreme cases. With F, the firm never does any short-term borrowing; with R, the firm never has a cash reserve (an investment in marketable securities). Figure 18.6 illustrates these two policies along with a compromise, Policy C.

With this compromise approach, the firm borrows in the short term to cover peak financing needs, but it maintains a cash reserve in the form of marketable securities during slow periods. As current assets build up, the firm draws down this reserve before doing any short-term borrowing. This allows for some run-up in current assets before the firm has to resort to short-term borrowing.

CURRENT ASSETS AND LIABILITIES IN PRACTICE

Short-term assets represent a significant portion of a typical firm's overall assets. For U.S. manufacturing, mining, and trade corporations, current assets were about 50 percent of total assets in the 1960s. Today, this figure is closer to 40 percent. Most of the decline is due to more efficient cash and inventory management. Over this same period, current liabilities rose from about 20 percent of total liabilities and equity to almost 30 percent. The result is that liquidity (as measured by the ratio of net working capital to total assets) has declined, signaling a move to more restrictive short-term policies.

Concept Questions

- 18.3a** What keeps the real world from being an ideal one in which net working capital could always be zero?
- 18.3b** What considerations determine the optimal size of the firm's investment in current assets?
- 18.3c** What considerations determine the optimal compromise between flexible and restrictive net working capital policies?

The Cash Budget

The **cash budget** is a primary tool in short-run financial planning. It allows the financial manager to identify short-term financial needs and opportunities. An important function of the cash budget is to help the manager explore the need for short-term borrowing. The idea of the cash budget is simple: It records estimates of cash receipts (cash in) and disbursements (cash out). The result is an estimate of the cash surplus or deficit.

SALES AND CASH COLLECTIONS

We start with an example involving the Fun Toys Corporation. We will prepare a quarterly cash budget. We could just as well use a monthly, weekly, or even daily basis. We choose quarters for convenience and also because a quarter is a common short-term business planning period. (Note that, throughout this example, all figures are in millions of dollars.)

All of Fun Toys' cash inflows come from the sale of toys. Cash budgeting for Fun Toys must start with a sales forecast for the coming year, by quarter:

	Q1	Q2	Q3	Q4
Sales (in millions)	\$200	\$300	\$250	\$400

Note that these are predicted sales, so there is forecasting risk here, and actual sales could be more or less. Fun Toys started the year with accounts receivable equal to \$120.

Fun Toys has a 45-day receivables, or average collection, period. This means that half of the sales in a given quarter will be collected the following quarter. This happens because sales made during the first 45 days of a quarter will be collected in that quarter, whereas sales made in the second 45 days will be collected in the next quarter. Note that we are assuming that each quarter has 90 days, so the 45-day collection period is the same as a half-quarter collection period.

Based on the sales forecasts, we now need to estimate Fun Toys' projected cash collections. First, any receivables that we have at the beginning of a quarter will be collected within 45 days, so all of them will be collected sometime during the quarter. Second, as we discussed, any sales made in the first half of the quarter will be collected, so total cash collections are:

$$\text{Cash collections} = \text{Beginning accounts receivable} + \frac{1}{2} \times \text{Sales}$$

For example, in the first quarter, cash collections would be the beginning receivables of \$120 plus half of sales, $\frac{1}{2} \times \$200 = \100 , for a total of **\$220**.

Because beginning receivables are all collected along with half of sales, ending receivables for a particular quarter will be the other half of sales. First-quarter sales are projected at \$200, so ending receivables will be \$100. This will be the beginning receivables in the second quarter. Cash collections in the second quarter will be \$100 plus half of the projected \$300 in sales, or **\$250** total.

Continuing this process, we can summarize Fun Toys' projected cash collections as shown in Table 18.2.

	Q1	Q2	Q3	Q4
Beginning receivables	\$120	\$100	\$150	\$125
Sales	200	300	250	400
Cash collections	$\frac{200}{2} = 100$	$\frac{300}{2} = 150$	$\frac{250}{2} = 125$	$\frac{400}{2} = 200$
Ending receivables	\$100	\$150	\$125	\$200

$$\begin{aligned} \text{Collections} &= \text{Beginning receivables} + \frac{1}{2} \times \text{Sales} \\ \text{Ending receivables} &= \text{Beginning receivables} + \text{Sales} - \text{Collections} \\ &= \frac{1}{2} \times \text{Sales} \end{aligned}$$

18.4

Excel Master It!



Excel Master
coverage online

cash budget

A forecast of cash receipts and disbursements for the next planning period.

18.6



See the Finance section of www.toolkit.com for several useful templates, including a cash flow budget.

TABLE 18.2

Cash Collection for Fun Toys (in millions)

In Table 18.2, collections are shown as the only source of cash. Of course, this need not be the case. Other sources of cash could include asset sales, investment income, and receipts from planned long-term financing.

CASH OUTFLOWS

Next, we consider the cash disbursements, or payments. These come in four basic categories:

1. *Payments of accounts payable*: These are payments for goods or services rendered by suppliers, such as raw materials. Generally, these payments will be made sometime after purchases.
2. *Wages, taxes, and other expenses*: This category includes all other regular costs of doing business that require actual expenditures. Depreciation, for example, is often thought of as a regular cost of business; but it requires no cash outflow and is not included.
3. *Capital expenditures*: These are payments of cash for long-lived assets.
4. *Long-term financing expenses*: This category includes, for example, interest payments on long-term debt outstanding and dividend payments to shareholders.

Fun Toys' purchases from suppliers (in dollars) in a quarter are equal to 60 percent of the next quarter's predicted sales. Fun Toys' payments to suppliers are equal to the previous quarter's purchases, so the accounts payable period is 90 days. For example, in the quarter just ended, Fun Toys ordered $.60 \times \$200 = \120 in supplies. This will actually be paid in the first quarter (Q1) of the coming year.

Wages, taxes, and other expenses are routinely 20 percent of sales; interest and dividends are currently \$20 per quarter. In addition, Fun Toys plans a major plant expansion (a capital expenditure) costing \$100 in the second quarter. If we put all this information together, the cash outflows are as shown in Table 18.3.

THE CASH BALANCE

The predicted *net cash inflow* is the difference between cash collections and cash disbursements. The net cash inflow for Fun Toys is shown in Table 18.4. What we see immediately is that there is a cash surplus in the first and third quarters and a cash deficit in the second and fourth quarters.

TABLE 18.3

Cash Disbursements for Fun Toys (in millions)

	Q1	Q2	Q3	Q4
Payment of accounts (60% of sales)	\$ 120	\$ 180	\$ 150	\$ 240
Wages, taxes, other expenses	40	60	50	80
Capital expenditures	0	100	0	0
Long-term financing expenses (interest and dividends)	<u>20</u>	<u>20</u>	<u>20</u>	<u>20</u>
Total cash disbursements	\$180	\$360	\$220	\$340

TABLE 18.4

Net Cash Inflow for Fun Toys (in millions)

	Q1	Q2	Q3	Q4
Total cash collections	\$220	\$250	\$275	\$325
Total cash disbursements	<u>180</u>	<u>360</u>	<u>220</u>	<u>340</u>
Net cash inflow	\$ 40	-\$110	\$ 55	-\$ 15

	Q1	Q2	Q3	Q4
Beginning cash balance	\$20	\$ 60	-\$50	\$ 5
Net cash inflow	<u>40</u>	<u>- 110</u>	<u>55</u>	<u>- 15</u>
Ending cash balance	\$60	-\$ 50	\$ 5	-\$10
Minimum cash balance	- 10	- 10	- 10	- 10
Cumulative surplus (deficit)	\$50	-\$ 60	-\$ 5	-\$20

TABLE 18.5

Cash Balance for Fun Toys (in millions)

We will assume that Fun Toys starts the year with a \$20 cash balance. Furthermore, Fun Toys maintains a \$10 minimum cash balance to guard against unforeseen contingencies and forecasting errors. So, the company starts the first quarter with \$20 in cash. This amount rises by \$40 during the quarter, and the ending balance is \$60. Of this, \$10 is reserved as a minimum, so we subtract it out and find that the first-quarter surplus is $\$60 - 10 = \50 .

Fun Toys starts the second quarter with \$60 in cash (the ending balance from the previous quarter). There is a net cash inflow of $-\$110$, so the ending balance is $\$60 - 110 = -\50 . We need another \$10 as a buffer, so the total deficit is $-\$60$. These calculations and those for the last two quarters are summarized in Table 18.5.

At the end of the second quarter, Fun Toys has a cash shortfall of \$60. This occurs because of the seasonal pattern of sales (higher toward the end of the second quarter), the delay in collections, and the planned capital expenditure.

The cash situation at Fun Toys is projected to improve to a \$5 deficit in the third quarter; but, by year's end, Fun Toys still has a \$20 deficit. Without some sort of financing, this deficit will carry over into the next year. We explore this subject in the next section.

For now, we can make the following general comments about Fun Toys' cash needs:

1. Fun Toys' large outflow in the second quarter is not necessarily a sign of trouble. It results from delayed collections on sales and a planned capital expenditure (presumably a worthwhile one).
2. The figures in our example are based on a forecast. Sales could be much worse (or better) than the forecast figures.

Concept Questions

18.4a How would you do a sensitivity analysis (discussed in Chapter 11) for Fun Toys' net cash balance?

18.4b What could you learn from such an analysis?

Short-Term Borrowing

Fun Toys has a short-term financing problem. It cannot meet the forecast cash outflows in the second quarter using internal sources. How it will finance that shortfall depends on its financial policy. With a very flexible policy, Fun Toys might seek up to \$60 million in long-term debt financing.

In addition, note that much of the cash deficit comes from the large capital expenditure. Arguably, this is a candidate for long-term financing. Nonetheless, because we have discussed long-term financing elsewhere, we will concentrate here on two short-term borrowing options: (1) unsecured borrowing and (2) secured borrowing.

18.5

UNSECURED LOANS

line of credit

A formal (committed) or informal (noncommitted) prearranged, short-term bank loan.

The most common way to finance a temporary cash deficit is to arrange a short-term unsecured bank loan. Firms that use short-term bank loans often arrange for a line of credit. A **line of credit** is an agreement under which a firm is authorized to borrow up to a specified amount. To ensure that the line is used for short-term purposes, the lender will sometimes require the borrower to pay the line down to zero and keep it there for some period during the year, typically 60 days (called a *cleanup period*).

Short-term lines of credit are classified as either *committed* or *noncommitted*. The latter type is an informal arrangement that allows firms to borrow up to a previously specified limit without going through the normal paperwork (much as they would with a credit card). A *revolving credit arrangement* (or *revolver*) is similar to a line of credit, but it is usually open for two or more years, whereas a line of credit would usually be evaluated on an annual basis.

Committed lines of credit are more formal legal arrangements that usually involve a commitment fee paid by the firm to the bank (usually the fee is on the order of .25 percent of the total committed funds per year). The interest rate on the line of credit is usually set equal to the bank's prime lending rate plus an additional percentage, and the rate will usually float. A firm that pays a commitment fee for a committed line of credit is essentially buying insurance to guarantee that the bank can't back out of the agreement (absent some material change in the borrower's status).

compensating balance

Money kept by the firm with a bank in low-interest or non-interest-bearing accounts as part of a loan agreement.

Compensating Balances As a part of a credit line or other lending arrangement, banks will sometimes require that the firm keep some amount of money on deposit. This is called a compensating balance. A **compensating balance** is some of the firm's money kept by the bank in low-interest or non-interest-bearing accounts. By leaving these funds with the bank and receiving little or no interest, the firm further increases the effective interest rate earned by the bank on the line of credit, thereby "compensating" the bank. A compensating balance might be on the order of 2 to 5 percent of the amount borrowed.

Firms also use compensating balances to pay for noncredit bank services such as cash management services. A traditionally contentious issue is whether the firm should pay for bank credit and noncredit services with fees or with compensating balances. Most major firms have now negotiated for banks to use the corporation's collected funds for compensation and use fees to cover any shortfall. Arrangements such as this one and some similar approaches discussed in the next chapter make the subject of minimum balances less of an issue than it once was.

Cost of a Compensating Balance A compensating balance requirement has an obvious opportunity cost because the money often must be deposited in an account with a zero or low interest rate. For example, suppose that we have a \$100,000 line of credit with a 10 percent compensating balance requirement. This means that 10 percent of the amount actually used must be left on deposit in a non-interest-bearing account.

The quoted interest rate on the credit line is 16 percent. Suppose we need \$54,000 to purchase some inventory. How much do we have to borrow? What interest rate are we effectively paying?

If we need \$54,000, we have to borrow enough so that \$54,000 is left over after we take out the 10 percent compensating balance:

$$\begin{aligned} \$54,000 &= (1 - .10) \times \text{Amount borrowed} \\ \text{Amount borrowed} &= \$54,000 / .90 = \$60,000 \end{aligned}$$

The interest on the \$60,000 for one year at 16 percent is $\$60,000 \times .16 = \$9,600$. We're actually getting only \$54,000 to use, so the effective interest rate is:

$$\begin{aligned}\text{Effective interest rate} &= \text{Interest paid/Amount available} \\ &= \$9,600/\$54,000 \\ &= .1778, \text{ or } 17.78\%\end{aligned}$$

Notice that what effectively happens here is that we pay 16 cents in interest on every 90 cents we borrow because we don't get to use the 10 cents tied up in the compensating balance. The interest rate is $.16/.90 = .1778$, or 17.78%, as we calculated.

Several points bear mentioning. First, compensating balances are usually computed as a monthly *average* of the daily balances. This means that the effective interest rate may be lower than our example illustrates. Second, it has become common for compensating balances to be based on the *unused* amount of the credit line. The requirement of such a balance amounts to an implicit commitment fee. Third, and most important, the details of any short-term business lending arrangements are highly negotiable. Banks will generally work with firms to design a package of fees and interest.

Letters of Credit A *letter of credit* is a common arrangement in international finance. With a letter of credit, the bank issuing the letter promises to make a loan if certain conditions are met. Typically, the letter guarantees payment on a shipment of goods provided that the goods arrive as promised. A letter of credit can be revocable (subject to cancellation) or irrevocable (not subject to cancellation if the specified conditions are met).

SECURED LOANS

Banks and other finance companies often require security for a short-term loan just as they do for a long-term loan. Security for short-term loans usually consists of accounts receivable, inventories, or both.

Accounts Receivable Financing **Accounts receivable financing** involves either *assigning* receivables or *factoring* receivables. Under assignment, the lender has the receivables as security, but the borrower is still responsible if a receivable can't be collected. With *conventional factoring*, the receivable is discounted and sold to the lender (the factor). Once it is sold, collection is the factor's problem, and the factor assumes the full risk of default on bad accounts. With *maturity factoring*, the factor forwards the money on an agreed-upon future date.

Factors play a particularly important role in the retail industry. Retailers in the clothing business, for example, must buy large amounts of new clothes at the beginning of the season. Because it is typically a long time before they sell anything, they wait to pay their suppliers, sometimes 30 to 60 days. If an apparel maker can't wait that long, it turns to factors, who buy the receivables and take over collection. Historically, the garment industry accounts for about 80 percent of all factoring in the United States.

One of the newest types of factoring is called *credit card receivable funding* or *business cash advances*. The way business cash advances work is that a company goes to a factor and receives cash up front. From that point on, a portion of each credit card sale (perhaps 6 to 8 percent) is routed directly to the factor by the credit card processor until the loan is paid off. This arrangement may be attractive to small businesses in particular, but it can be expensive. The typical premium on the advance is about 35 percent—meaning that with a \$100,000 loan, \$135,000 must be repaid within a relatively short period.

Purchase order financing (or PO financing) is a popular form of factoring used by small and midsize companies. In a typical scenario, a small business receives a firm order from

accounts receivable financing

A secured short-term loan that involves either the assignment or the factoring of receivables.

a customer, but it doesn't have sufficient funds to pay the supplier who manufactures the product. With PO financing, the factor pays the supplier. When the sale is completed and the seller is paid, the factor is repaid. A typical interest rate on purchase order factoring is 3.5 percent for the first 30 days, then 1.25 percent every 10 days after, which results in an annual interest rate above 50 percent.

EXAMPLE 18.3

Cost of Factoring

For the year just ended, LuLu's Pies had an average of \$50,000 in accounts receivable. Credit sales were \$500,000. LuLu's factors its receivables by discounting them 3 percent—in other words, by selling them for 97 cents on the dollar. What is the effective interest rate on this source of short-term financing?

To determine the interest rate, we first have to know the accounts receivable, or average collection, period. During the year, LuLu's turned over its receivables $\$500,000/\$50,000 = 10$ times. The average collection period is $365/10 = 36.5$ days.

The interest paid here is a form of discount interest (discussed in Chapter 6). In this case, LuLu's is paying 3 cents in interest on every 97 cents of financing. The interest rate per 36.5 days is $.03/.97 = .0309$, or 3.09%. The APR is $10 \times 3.09\% = 30.9\%$, but the effective annual rate is:

$$\text{EAR} = 1.0309^{10} - 1 = .356, \text{ or } 35.6\%$$

Factoring is a relatively expensive source of money in this case.

We should note that, if the factor takes on the risk of default by a buyer, then the factor is providing insurance as well as immediate cash. More generally, the factor essentially takes over the firm's credit operations. This can result in a significant savings. The interest rate we calculated is therefore overstated, particularly if default is a significant possibility.

inventory loan

A secured short-term loan to purchase inventory.

Inventory Loans **Inventory loans**, short-term loans to purchase inventory, come in three basic forms: blanket inventory liens, trust receipts, and field warehouse financing:

1. *Blanket inventory lien*: A blanket lien gives the lender a lien against all the borrower's inventories (the blanket "covers" everything).
2. *Trust receipt*: A trust receipt is a device by which the borrower holds specific inventory in "trust" for the lender. Automobile dealer financing, for example, is done by use of trust receipts. This type of secured financing is also called *floor planning*, in reference to inventory on the showroom floor. However, it is somewhat cumbersome to use trust receipts for, say, wheat grain.
3. *Field warehouse financing*: In field warehouse financing, a public warehouse company (an independent company that specializes in inventory management) acts as a control agent to supervise the inventory for the lender.

OTHER SOURCES

A variety of other sources of short-term funds are employed by corporations. Two of the most important are *commercial paper* and *trade credit*.

Commercial paper consists of short-term notes issued by large, highly rated firms. Typically, these notes are of short maturity, ranging up to 270 days (beyond that limit, the firm must file a registration statement with the SEC). Because the firm issues these directly and because it usually backs the issue with a special bank line of credit, the interest rate the firm obtains is often significantly below the rate a bank would charge for a direct loan.

Another option available to a firm is to increase the accounts payable period; in other words, the firm may take longer to pay its bills. This amounts to borrowing from suppliers

in the form of trade credit. This is an extremely important form of financing for smaller businesses in particular. As we discuss in Chapter 20, a firm using trade credit may end up paying a much higher price for what it purchases, so this can be a very expensive source of financing.

Concept Questions

18.5a What are the two basic forms of short-term financing?

18.5b Describe two types of secured loans.

A Short-Term Financial Plan

18.6

To illustrate a completed short-term financial plan, we will assume that Fun Toys arranges to borrow any needed funds on a short-term basis. The interest rate is a 20 percent APR, and it is calculated on a quarterly basis. From Chapter 6, we know that the rate is $20\%/4 = 5\%$ per quarter. We will assume that Fun Toys starts the year with no short-term debt.

From Table 18.5, we know that Fun Toys has a second-quarter deficit of \$60 million. The firm will have to borrow this amount. Net cash inflow in the following quarter is \$55 million. The firm will now have to pay $\$60 \text{ million} \times .05 = \3 million in interest out of that, leaving \$52 million to reduce the borrowing.

Fun Toys still owes $\$60 \text{ million} - 52 \text{ million} = \8 million at the end of the third quarter. Interest in the last quarter will be $\$8 \text{ million} \times .05 = .4 \text{ million}$. In addition, net inflows in the last quarter are $-\$15 \text{ million}$; so the company will have to borrow a total of \$15.4 million, bringing total borrowing up to $\$15.4 \text{ million} + 8 \text{ million} = \23.4 million . Table 18.6 extends Table 18.5 to include these calculations.

Notice that the ending short-term debt is equal to the cumulative deficit for the entire year, \$20 million, plus the interest paid during the year, $\$3 \text{ million} + .4 \text{ million} = \3.4 million , for a total of \$23.4 million.

Our plan is very simple. For example, we ignored the fact that the interest paid on the short-term debt is tax deductible. We also ignored the fact that the cash surplus in the first quarter would earn some interest (which would be taxable). We could add on a number of refinements. Even so, our plan highlights the fact that in about 90 days, Fun Toys will need to borrow \$60 million or so on a short-term basis. It's time to start lining up the source of the funds.

	Q1	Q2	Q3	Q4
Beginning cash balance	\$20	→ \$ 60	→ \$10	→ \$10.0
Net cash inflow	40	- 110	55	- 15.0
New short-term borrowing	0	60	0	15.4
Interest on short-term borrowing	0	0	- 3	- .4
Short-term borrowing repaid	0	0	- 52	0
Ending cash balance	\$60	\$ 10	\$10	\$10.0
Minimum cash balance	- 10	- 10	- 10	- 10.0
Cumulative surplus (deficit)	\$50	\$ 0	\$ 0	\$.0
Beginning short-term borrowing	0	→ 0	→ 60	→ 8.0
Change in short-term debt	0	60	- 52	15.4
Ending short-term debt	\$ 0	\$ 60	\$ 8	\$23.4

TABLE 18.6
Short-Term Financial Plan for Fun Toys (in millions)

Our plan also illustrates that financing the firm's short-term needs will cost about \$3.4 million in interest (before taxes) for the year. This is a starting point for Fun Toys to begin evaluating alternatives to reduce this expense. For example, can the \$100 million planned expenditure be postponed or spread out? At 5 percent per quarter, short-term credit is expensive.

Also, if Fun Toys' sales are expected to keep growing, then the deficit of \$20 million-plus will probably also keep growing, and the need for additional financing will be permanent. Fun Toys may wish to think about raising money on a long-term basis to cover this need.

Concept Questions

- 18.6a** In Table 18.6, does Fun Toys have a projected deficit or surplus?
- 18.6b** In Table 18.6, what would happen to Fun Toys' deficit or surplus if the minimum cash balance were reduced to \$5?

18.7 Summary and Conclusions

1. This chapter has introduced the management of short-term finance. Short-term finance involves short-lived assets and liabilities. We traced and examined the short-term sources and uses of cash as they appear on the firm's financial statements. We saw how current assets and current liabilities arise in the short-term operating activities and the cash cycle of the firm.
2. Managing short-term cash flows involves the minimizing of costs. The two major costs are carrying costs, the return forgone by keeping too much invested in short-term assets such as cash, and shortage costs, the costs of running out of short-term assets. The objective of managing short-term finance and doing short-term financial planning is to find the optimal trade-off between these two costs.
3. In an ideal economy, the firm could perfectly predict its short-term uses and sources of cash, and net working capital could be kept at zero. In the real world, cash and net working capital provide a buffer that lets the firm meet its ongoing obligations. The financial manager seeks the optimal level of each of the current assets.
4. The financial manager can use the cash budget to identify short-term financial needs. The cash budget tells the manager what borrowing is required or what lending will be possible in the short run. The firm has available to it a number of possible ways of acquiring funds to meet short-term shortfalls, including unsecured and secured loans.

CONNECT TO FINANCE



For more practice, you should be in *Connect Finance*. Log on to connect.mheducation.com to get started!

Can you answer the following Connect Quiz questions?

- Section 18.1** Give an example of an action that will increase cash.
- Section 18.2** A firm has an operating cycle of 64 days and a cash cycle of 21 days. How long will the firm's accounts payable period be if the firm decides to increase its accounts payable period by three days?
- Section 18.4** Galaxy Sales has a beginning cash balance of \$25. During the quarter, the firm had a net cash inflow of \$20. What is the cumulative surplus at the end of the quarter if the minimum cash balance is \$10?
- Section 18.5** What type of lending relies on a control agent to supervise inventory on behalf of a lender?

CHAPTER REVIEW AND SELF-TEST PROBLEMS

- 18.1 The Operating and Cash Cycles** Consider the following financial statement information for the Route 66 Company:

Item	Beginning	Ending
Inventory	\$1,273	\$1,401
Accounts receivable	3,782	3,368
Accounts payable	1,795	2,025
Net sales		\$14,750
Cost of goods sold		11,375

Calculate the operating and cash cycles.

- 18.2 Cash Balance for Greenwell Corporation** The Greenwell Corporation has a 60-day average collection period and wishes to maintain a \$160 million minimum cash balance. Based on this and the information given in the following cash budget, complete the cash budget. What conclusions do you draw?

GREENWELL CORPORATION Cash Budget (in millions)				
	Q1	Q2	Q3	Q4
Beginning receivables	\$240			
Sales	150	\$165	\$180	\$135
Cash collections	—	—	—	—
Ending receivables	—	—	—	—
Total cash collections				
Total cash disbursements	170	160	185	190
Net cash inflow	—	—	—	—
Beginning cash balance	\$ 45			
Net cash inflow	—	—	—	—
Ending cash balance	—	—	—	—
Minimum cash balance	—	—	—	—
Cumulative surplus (deficit)	—	—	—	—

ANSWERS TO CHAPTER REVIEW AND SELF-TEST PROBLEMS

- 18.1** We first need the turnover ratios. Note that we use the average values for all balance sheet items and that we base the inventory and payables turnover measures on cost of goods sold:

$$\text{Inventory turnover} = \$11,375/[(\$1,273 + 1,401)/2] = 8.51 \text{ times}$$

$$\text{Receivables turnover} = \$14,750/[(\$3,782 + 3,368)/2] = 4.13 \text{ times}$$

$$\text{Payables turnover} = \$11,375/[(\$1,795 + 2,025)/2] = 5.96 \text{ times}$$

We can now calculate the various periods:

$$\text{Inventory period} = 365 \text{ days}/8.51 \text{ times} = 42.90 \text{ days}$$

$$\text{Receivables period} = 365 \text{ days}/4.13 \text{ times} = 88.47 \text{ days}$$

$$\text{Payables period} = 365 \text{ days}/5.96 \text{ times} = 61.29 \text{ days}$$

So the time it takes to acquire inventory and sell it is about 43 days. Collection takes another 88 days, and the operating cycle is thus $43 + 88 = 131$ days. The cash cycle is 131 days less the payables period: $131 - 61 = 70$ days.

- 18.2** Because Greenwell has a 60-day collection period, only sales made in the first 30 days of the quarter will be collected in the same quarter. Total cash collections in the first quarter will thus equal $30/90 = 1/3$ of sales plus beginning receivables, or $1/3 \times \$150 + \$240 = \$290$. Ending receivables for the first quarter (and the second quarter beginning receivables) are the other $2/3$ of sales, or $2/3 \times \$150 = \100 . The remaining calculations are straightforward, and the completed budget is as follows:

GREENWELL CORPORATION Cash Budget (in millions)				
	Q1	Q2	Q3	Q4
Beginning receivables	\$240	\$100	\$110	\$120
Sales	150	165	180	135
Cash collections	290	155	170	165
Ending receivables	100	110	120	90
Total cash collections	290	155	170	165
Total cash disbursements	170	160	185	190
Net cash inflow	120	-5	-15	-25
Beginning cash balance	45	165	160	145
Net cash inflow	120	-5	-15	-25
Ending cash balance	165	160	145	120
Minimum cash balance	-160	-160	-160	-160
Cumulative surplus (deficit)	\$ 5	\$ 0	-\$ 15	-\$ 40

The primary conclusion from this schedule is that, beginning in the third quarter, Greenwell's cash surplus becomes a cash deficit. By the end of the year, Greenwell will need to arrange for \$40 million in cash beyond what will be available.

CONCEPTS REVIEW AND CRITICAL THINKING QUESTIONS

- Operating Cycle [LO1]** What are some of the characteristics of a firm with a long operating cycle?

2. **Cash Cycle [LO1]** What are some of the characteristics of a firm with a long cash cycle?
3. **Sources and Uses [LO4]** For the year just ended, you have gathered the following information about the Holly Corporation:
 - a. A \$200 dividend was paid.
 - b. Accounts payable increased by \$500.
 - c. Fixed asset purchases were \$900.
 - d. Inventories increased by \$625.
 - e. Long-term debt decreased by \$1,200.Label each as a source or use of cash and describe its effect on the firm's cash balance.
4. **Cost of Current Assets [LO2]** Shank Manufacturing, Inc., has recently installed a just-in-time (JIT) inventory system. Describe the effect this is likely to have on the company's carrying costs, shortage costs, and operating cycle.
5. **Operating and Cash Cycles [LO1]** Is it possible for a firm's cash cycle to be longer than its operating cycle? Explain why or why not.

Use the following information to answer Questions 6–10: Last month, BlueSky Airline announced that it would stretch out its bill payments to 45 days from 30 days. The reason given was that the company wanted to “control costs and optimize cash flow.” The increased payables period will be in effect for all of the company’s 4,000 suppliers.

6. **Operating and Cash Cycles [LO1]** What impact did this change in payables policy have on BlueSky’s operating cycle? Its cash cycle?
7. **Operating and Cash Cycles [LO1]** What impact did the announcement have on BlueSky’s suppliers?
8. **Corporate Ethics [LO1]** Is it ethical for large firms to unilaterally lengthen their payables periods, particularly when dealing with smaller suppliers?
9. **Payables Period [LO1]** Why don’t all firms increase their payables periods to shorten their cash cycles?
10. **Payables Period [LO1]** BlueSky lengthened its payables period to “control costs and optimize cash flow.” Exactly what is the cash benefit to BlueSky from this change?

QUESTIONS AND PROBLEMS

1. **Changes in the Cash Account [LO4]** Indicate the impact of the following corporate actions on cash, using the letter *I* for an increase, *D* for a decrease, or *N* when no change occurs:
 - a. A dividend is paid with funds received from a sale of debt.
 - b. Real estate is purchased and paid for with short-term debt.
 - c. Inventory is bought on credit.
 - d. A short-term bank loan is repaid.
 - e. Next year’s taxes are prepaid.
 - f. Preferred stock is redeemed.
 - g. Sales are made on credit.
 - h. Interest on long-term debt is paid.
 - i. Payments for previous sales are collected.



- j. The accounts payable balance is reduced.
 - k. A dividend is paid.
 - l. Production supplies are purchased and paid for with a short-term note.
 - m. Utility bills are paid.
 - n. Cash is paid for raw materials purchased for inventory.
 - o. Marketable securities are sold.
2. **Cash Equation [LO3]** Cori's Corp. has an equity value of \$13,315. Long-term debt is \$8,200. Net working capital, other than cash, is \$2,750. Fixed assets are \$17,380. How much cash does the company have? If current liabilities are \$2,025, what are current assets?
3. **Changes in the Operating Cycle [LO1]** Indicate the effect that the following will have on the operating cycle. Use the letter *I* to indicate an increase, the letter *D* for a decrease, and the letter *N* for no change:
- a. Average receivables goes up.
 - b. Credit repayment times for customers are increased.
 - c. Inventory turnover goes from 3 times to 6 times.
 - d. Payables turnover goes from 6 times to 11 times.
 - e. Receivables turnover goes from 7 times to 9 times.
 - f. Payments to suppliers are accelerated.
4. **Changes in Cycles [LO1]** Indicate the impact of the following on the cash and operating cycles, respectively. Use the letter *I* to indicate an increase, the letter *D* for a decrease, and the letter *N* for no change:
- a. The terms of cash discounts offered to customers are made less favorable.
 - b. The cash discounts offered by suppliers are decreased; thus, payments are made earlier.
 - c. An increased number of customers begin to pay in cash instead of with credit.
 - d. Fewer raw materials than usual are purchased.
 - e. A greater percentage of raw material purchases are paid for with credit.
 - f. More finished goods are produced for inventory instead of for order.
- ☒ 5. **Calculating Cash Collections [LO3]** The Morning Jolt Coffee Company has projected the following quarterly sales amounts for the coming year:

	Q1	Q2	Q3	Q4
Sales	\$850	\$880	\$960	\$1,040

- a. Accounts receivable at the beginning of the year are \$365. The company has a 45-day collection period. Calculate cash collections in each of the four quarters by completing the following:

	Q1	Q2	Q3	Q4
Beginning receivables				
Sales				
Cash collections				
Ending receivables				

- b. Rework (a) assuming a collection period of 60 days.
 c. Rework (a) assuming a collection period of 30 days.

- 6. Calculating Cycles [LO1]** Consider the following financial statement information for the Newk Corporation:

Item	Beginning	Ending
Inventory	\$11,718	\$14,865
Accounts receivable	5,860	6,127
Accounts payable	7,930	8,930
Credit sales		\$127,382
Cost of goods sold		76,157

Calculate the operating and cash cycles. How do you interpret your answer?

- 7. Factoring Receivables [LO3]** Your firm has an average collection period of 31 days. Current practice is to factor all receivables immediately at a discount of 1.25 percent. What is the effective cost of borrowing in this case? Assume that default is extremely unlikely.
- 8. Calculating Payments [LO3]** Sexton Corp. has projected the following sales for the coming year:

	Q1	Q2	Q3	Q4
Sales	\$810	\$880	\$840	\$930

Sales in the year following this one are projected to be 15 percent greater in each quarter.

- a. Calculate payments to suppliers assuming that the company places orders during each quarter equal to 30 percent of projected sales for the next quarter. Assume that the company pays immediately. What is the payables period in this case?

	Q1	Q2	Q3	Q4
Payment of accounts	\$	\$	\$	\$

- b. Rework (a) assuming a 90-day payables period.
c. Rework (a) assuming a 60-day payables period.

- 9. Calculating Payments [LO3]** The Torrey Pine Corporation's purchases from suppliers in a quarter are equal to 75 percent of the next quarter's forecast sales. The payables period is 60 days. Wages, taxes, and other expenses are 20 percent of sales, and interest and dividends are \$90 per quarter. No capital expenditures are planned.

Projected quarterly sales are shown here:

	Q1	Q2	Q3	Q4
Sales	\$1,670	\$2,065	\$1,810	\$1,530

Sales for the first quarter of the following year are projected at \$2,025. Calculate the company's cash outlays by completing the following:

	Q1	Q2	Q3	Q4
Payment of accounts				
Wages, taxes, other expenses				
Long-term financing expenses (interest and dividends)				
Total				

- 10. Calculating Cash Collections [LO3]** The following is the sales budget for Profit, Inc., for the first quarter of 2018:

	January	February	March
Sales budget	\$196,000	\$215,000	\$236,000

Credit sales are collected as follows:

- 65 percent in the month of the sale
- 20 percent in the month after the sale
- 15 percent in the second month after the sale

The accounts receivable balance at the end of the previous quarter was \$87,000 (\$61,000 of which was uncollected December sales).

- a. Compute the sales for November.
 - b. Compute the sales for December.
 - c. Compute the cash collections from sales for each month from January through March.
- 11. Calculating the Cash Budget [LO3]** Here are some important figures from the budget of Nashville Nougats, Inc., for the second quarter of 2018:

	April	May	June
Credit sales	\$336,900	\$314,500	\$378,400
Credit purchases	134,100	152,400	180,300
Cash disbursements			
Wages, taxes, and expenses	48,910	62,300	67,600
Interest	11,320	11,320	11,320
Equipment purchases	79,900	122,000	0

The company predicts that 5 percent of its credit sales will never be collected, 35 percent of its sales will be collected in the month of the sale, and the remaining 60 percent will be collected in the following month. Credit purchases will be paid in the month following the purchase.

In March 2018, credit sales were \$211,500 and credit purchases were \$145,200. Using this information, complete the following cash budget:

	April	May	June
Beginning cash balance	\$121,000		
Cash receipts			
Cash collections from credit sales			
Total cash available			
Cash disbursements			
Purchases			
Wages, taxes, and expenses			
Interest			
Equipment purchases			
Total cash disbursements			
Ending cash balance			

- 12. Sources and Uses [LO4]** Below are the most recent balance sheets for Country Kettles, Inc. Excluding accumulated depreciation, determine whether each item is a source or a use of cash and the amount:

COUNTRY KETTLES, INC. Balance Sheets		
	2016	2017
Assets		
Cash	\$ 36,740	\$ 35,719
Accounts receivable	84,583	88,746
Inventories	73,568	77,121
Property, plant, and equipment	181,340	190,188
Less: Accumulated depreciation	<u>55,300</u>	<u>60,381</u>
Total assets	<u>\$320,931</u>	<u>\$331,393</u>
Liabilities and Equity		
Accounts payable	\$ 59,863	\$ 61,350
Accrued expenses	7,599	6,815
Long-term debt	30,976	33,800
Common stock	19,000	23,000
Accumulated retained earnings	<u>203,493</u>	<u>206,428</u>
Total liabilities and equity	<u>\$320,931</u>	<u>\$331,393</u>

- 13. Costs of Borrowing [LO3]** You've worked out a line of credit arrangement that allows you to borrow up to \$40 million at any time. The interest rate is .36 percent per month. In addition, 4 percent of the amount that you borrow must be deposited in a non-interest-bearing account. Assume that your bank uses compound interest on its line of credit loans.
- What is the effective annual interest rate on this lending arrangement?
 - Suppose you need \$13 million today and you repay it in six months. How much interest will you pay?
- 14. Costs of Borrowing [LO3]** A bank offers your firm a revolving credit arrangement for up to \$50 million at an interest rate of 1.65 percent per quarter. The bank also requires you to maintain a compensating balance of 5 percent against the *unused* portion of the credit line, to be deposited in a non-interest-bearing account. Assume you have a short-term investment account at the bank that pays .75 percent per quarter, and assume that the bank uses compound interest on its revolving credit loans.
- What is your effective annual interest rate (an opportunity cost) on the revolving credit arrangement if your firm does not use it during the year?
 - What is your effective annual interest rate on the lending arrangement if you borrow \$30 million immediately and repay it in one year?
 - What is your effective annual interest rate if you borrow \$50 million immediately and repay it in one year?
- 15. Calculating the Cash Budget [LO3]** Wildcat, Inc., has estimated sales (in millions) for the next four quarters as follows:

INTERMEDIATE

(Questions 13–16)

	Q1	Q2	Q3	Q4
Sales	\$170	\$185	\$200	\$225

Sales for the first quarter of the following year are projected at \$180 million. Accounts receivable at the beginning of the year were \$71 million. Wildcat has a 45-day collection period.

Wildcat's purchases from suppliers in a quarter are equal to 45 percent of the next quarter's forecast sales, and suppliers are normally paid in 36 days. Wages, taxes, and other expenses run about 25 percent of sales. Interest and dividends are \$14 million per quarter.

Wildcat plans a major capital outlay in the second quarter of \$85 million. Finally, the company started the year with a \$54 million cash balance and wishes to maintain a \$30 million minimum balance.

- Complete a cash budget for Wildcat by filling in the following:

WILDCAT, INC. Cash Budget (in millions)		Q1	Q2	Q3	Q4
Beginning cash balance	\$54				
Net cash inflow					
Ending cash balance					
Minimum cash balance	30				
Cumulative surplus (deficit)					

- Assume that Wildcat can borrow any needed funds on a short-term basis at a rate of 3 percent per quarter and can invest any excess funds in short-term marketable securities at a rate of 2 percent per quarter. Prepare a short-term financial plan by filling in the following schedule. What is the net cash cost (total interest paid minus total investment income earned) for the year?

WILDCAT, INC. Short-Term Financial Plan (in millions)		Q1	Q2	Q3	Q4
Target cash balance	\$30				
Net cash inflow					
New short-term investments					
Income from short-term investments					
Short-term investments sold					
New short-term borrowing					
Interest on short-term borrowing					
Short-term borrowing repaid					
Ending cash balance					
Minimum cash balance					
Cumulative surplus (deficit)					
Beginning short-term investments					
Ending short-term investments					
Beginning short-term debt					
Ending short-term debt					

- Cash Management Policy [LO3]** Rework Problem 15 assuming:
 - Wildcat maintains a minimum cash balance of \$40 million.
 - Wildcat maintains a minimum cash balance of \$20 million.

Based on your answers in (a) and (b), do you think the firm can boost its profit by changing its cash management policy? Are there other factors that must be considered as well? Explain.

- 17. Costs of Borrowing [LO3]** In exchange for a \$300 million fixed commitment line of credit, your firm has agreed to do the following:

1. Pay 1.85 percent per quarter on any funds actually borrowed.
2. Maintain a 4.5 percent compensating balance on any funds actually borrowed.
3. Pay an up-front commitment fee of .25 percent of the amount of the line.

Based on this information, answer the following:

- a. Ignoring the commitment fee, what is the effective annual interest rate on this line of credit?
- b. Suppose your firm immediately uses \$115 million of the line and pays it off in one year. What is the effective annual interest rate on this \$115 million loan?

- 18. Costs of Borrowing [LO3]** Cheap Money Bank offers your firm a *discount* interest loan at 8.25 percent for up to \$25 million and, in addition, requires you to maintain a 5 percent compensating balance against the amount borrowed. What is the effective annual interest rate on this lending arrangement?

CHALLENGE

(Questions 17–18)

EXCEL MASTER IT! PROBLEMS

Heidi Pedersen, the treasurer for Wood Products, Inc., has just been asked by Justin Wood, the company's president, to prepare a memo detailing the company's ending cash balance for the next three months. Below, you will see the relevant estimates for this period.



	July	August	September
Credit sales	\$1,275,800	\$1,483,500	\$1,096,300
Credit purchases	765,480	890,160	657,780
Cash disbursements			
Wages, taxes, and expenses	348,600	395,620	337,150
Interest	29,900	29,900	29,900
Equipment	0	158,900	96,300
Credit sales collections			
Collected in month of sale	35%		
Collected month after sale	60%		
Never collected	5%		
June credit sales	\$1,135,020		
June credit purchases	\$ 681,012		
Beginning cash balance	\$ 425,000		

All credit purchases are paid in the month after the purchase.

- a. Complete the cash budget for Wood Products for the next three months.
- b. Heidi knows that the cash budget will become a standard report completed before each quarter. To help reduce the time preparing the report each quarter, she would like a memo with the appropriate information in Excel linked to the memo. Prepare a memo to Justin that will automatically update when the values are changed in Excel.

MINICASE

Piepkorn Manufacturing Working Capital Management

You have recently been hired by Piepkorn Manufacturing to work in the newly established treasury department. Piepkorn Manufacturing is a small company that produces cardboard boxes in a variety of sizes for different purchasers. Gary Piepkorn, the owner of the company, works primarily in the sales and production areas of the company. Currently, the company puts all receivables in one shoe box and all payables in another. Because of the disorganized system, the finance area needs work, and that's what you've been brought in to do.

The company currently has a cash balance of \$305,000, and it plans to purchase new box-folding machinery in the fourth quarter at a cost of \$525,000. The machinery will be purchased with cash because of a discount offered. The company's policy is to maintain a minimum cash balance of \$125,000. All sales and purchases are made on credit.

Gary Piepkorn has projected the following gross sales for each of the next four quarters:

	Q1	Q2	Q3	Q4
Gross sales	\$1,310,000	\$1,390,000	\$1,440,000	\$1,530,000

Also, gross sales for the first quarter of the next year are projected at \$1,405,000. Piepkorn currently has an accounts receivable period of 53 days and an accounts receivable balance of \$645,000. Twenty percent of the accounts receivable balance is from a company that has just entered bankruptcy, and it is likely this portion of the accounts receivable will never be collected.

Piepkorn typically orders 50 percent of next quarter's projected gross sales in the current quarter, and suppliers are typically paid in 42 days. Wages, taxes, and other costs run about 30 percent of gross sales. The company has a quarterly interest payment of \$135,000 on its long-term debt.

The company uses a local bank for its short-term financial needs. It pays 1.5 percent per quarter on all short-term

borrowing and maintains a money market account that pays 1 percent per quarter on all short-term deposits.

Gary has asked you to prepare a cash budget and short-term financial plan for the company under the current policies. He has also asked you to prepare additional plans based on changes in several inputs.

QUESTIONS

1. Use the numbers given to complete the cash budget and short-term financial plan.
2. Rework the cash budget and short-term financial plan assuming Piepkorn changes to a minimum balance of \$100,000.
3. You have looked at the credit policy offered by Piepkorn's competitors and have determined that the industry standard credit policy is 1/10, net 40.* The discount will begin to be offered on the first day of the first quarter. You want to examine how this credit policy would affect the cash budget and short-term financial plan. If this credit policy is implemented, you believe that 40 percent of all sales will take advantage of it, and the accounts receivable period will decline to 36 days. Rework the cash budget and short-term financial plan under the new credit policy and a minimum cash balance of \$100,000. What interest rate are you effectively offering customers?
4. You have talked to the company's suppliers about the credit terms Piepkorn receives. Currently, the company receives terms of net 45. The suppliers have stated that they would offer new credit terms of 1.5/15, net 40. The discount would begin to be offered on the first day of the first quarter. What interest rate are the suppliers offering the company? Rework the cash budget and short-term financial plan assuming you take the credit terms on all orders and the minimum cash balance is \$100,000. Also assume that Piepkorn offers the credit terms detailed in Question 3.

PIEPKORN MANUFACTURING Cash Budget				
	Q1	Q2	Q3	Q4
Target cash balance				
Net cash inflow				
Ending cash balance				
Minimum cash balance	—	—	—	—
Cumulative surplus (deficit)				

*If you are not familiar with credit policy quotations, see Chapter 20.

PIEPKORN MANUFACTURING Short-Term Financial Plan		Q1	Q2	Q3	Q4
Target cash balance					
Net cash inflow					
New short-term investments					
Income from short-term investments					
Short-term investments sold					
New short-term borrowing					
Interest on short-term borrowing					
Short-term borrowing repaid		—	—	—	—
Ending cash balance					
Minimum cash balance		—	—	—	—
Cumulative surplus (deficit)					
Beginning short-term investments					
Ending short-term investments					
Beginning short-term debt					
Ending short-term debt					

BY ANY MEASURE, THE CASH BALANCE at U.S. corporations is huge. In the middle of 2017, the cash balance at companies in the S&P 500 excluding financials, transportation, and utilities, reached \$1.496 trillion, a record level. Tech giants Cisco and Microsoft, for example, held about \$70 billion and \$132 billion in cash, respectively. In Cisco's case, the cash amounted to just under one-half of the company's total market cap. It's hard to believe, but these numbers might understate things. Apple, for example, reported about \$70 billion in cash and short-term investments, but the company chose to stash most of its cash in longer-term investments. How much? About \$180 billion, so Apple's total cash hoard was a mind-boggling \$250 billion!

Learning Objectives

After studying this chapter, you should be able to:

- L01** Outline the importance of float and how it affects cash balances.
- L02** Explain how firms manage their cash and some of the collection,
- L03** Describe the advantages and disadvantages to holding cash and some of the ways to invest idle cash.

©by_adri/iStockPhoto/Getty/images

For updates on the latest happenings in finance, visit fundamentals-of-corporate-finance.blogspot.com.

This chapter is about how firms manage cash. The basic objective in cash management is to keep the investment in cash as low as possible while still keeping the firm operating efficiently and effectively. This goal usually reduces to the dictum, “Collect early and pay late.” Accordingly, we discuss ways of accelerating collections and managing disbursements.

In addition, firms must invest temporarily idle cash in short-term marketable securities. As we discuss in various places, these securities can be bought and sold in the financial markets. As a group, they have very little default risk, and most are highly marketable. There are different types of these so-called money market securities, and in this chapter we discuss a few of the most important ones.

Reasons for Holding Cash

19.1

John Maynard Keynes, in his classic work *The General Theory of Employment, Interest, and Money*, identified three motives for liquidity: The speculative motive, the precautionary motive, and the transaction motive. We discuss these next.

THE SPECULATIVE AND PRECAUTIONARY MOTIVES

The **speculative motive** is the need to hold cash in order to be able to take advantage of, for example, bargain purchases that might arise, attractive interest rates, and (in the case of international firms) favorable exchange rate fluctuations.

For most firms, reserve borrowing ability and marketable securities can be used to satisfy speculative motives. Thus, there might be a speculative motive for maintaining liquidity, but not necessarily for holding cash. Think of it this way: If you have a credit card with a very large credit limit, then you can probably take advantage of any unusual bargains that come along without carrying any cash.

This is also true, to a lesser extent, for precautionary motives. The **precautionary motive** is the need for a safety supply to act as a financial reserve. Once again, there probably is a precautionary motive for maintaining liquidity. However, given that the value of money market instruments is relatively certain and that instruments such as T-bills are extremely liquid, there is no real need to hold substantial amounts of cash for precautionary purposes.

speculative motive

The need to hold cash to take advantage of additional investment opportunities, such as bargain purchases.

precautionary motive

The need to hold cash as a safety margin to act as a financial reserve.

THE TRANSACTION MOTIVE

Cash is needed to satisfy the **transaction motive**, the need to have cash on hand to pay bills. Transaction-related needs come from the normal disbursement and collection activities of the firm. The disbursement of cash includes the payment of wages and salaries, trade debts, taxes, and dividends.

Cash is collected from product sales, the selling of assets, and new financing. The cash inflows (collections) and outflows (disbursements) are not perfectly synchronized and some level of cash holdings is necessary to serve as a buffer.

As electronic funds transfers and other high-speed, “paperless” payment mechanisms continue to develop, even the transaction demand for cash may all but disappear. Even if it does, there will still be a demand for liquidity and a need to manage it efficiently.

transaction motive

The need to hold cash to satisfy normal disbursement and collection activities associated with a firm's ongoing operations.

COMPENSATING BALANCES

Compensating balances are another reason to hold cash. As we discussed in the previous chapter, cash balances are kept at commercial banks to compensate for banking services the firm receives. A minimum compensating balance requirement may impose a lower limit on the level of cash a firm holds.

COSTS OF HOLDING CASH

When a firm holds cash in excess of some necessary minimum, it incurs an opportunity cost. The opportunity cost of excess cash (held in currency or bank deposits) is the interest income that could be earned in the next best use, such as an investment in marketable securities.

Given the opportunity cost of holding cash, why would a firm hold cash in excess of its compensating balance requirements? The answer is that a cash balance must be maintained to provide the liquidity necessary for transaction needs—paying bills. If the firm maintains too small a cash balance, it may run out of cash. If this happens, the firm may have to raise

cash on a short-term basis. This could involve, for example, selling marketable securities or borrowing.

Activities such as selling marketable securities and borrowing involve various costs. As we've discussed, holding cash has an opportunity cost. To determine the appropriate cash balance, the firm must weigh the benefits of holding cash against these costs. We discuss this subject in more detail in the sections that follow.

CASH MANAGEMENT VERSUS LIQUIDITY MANAGEMENT

Before we move on, we should note that it is important to distinguish between true cash management and a more general subject, liquidity management. The distinction is a source of confusion because the word *cash* is used in practice in two different ways. First of all, it has its literal meaning: Actual cash on hand. However, financial managers frequently use the word in another way to describe a firm's holdings of cash along with its marketable securities, and marketable securities are sometimes called *cash equivalents* or *near-cash*. In our discussion of Cisco's and Microsoft's cash positions at the beginning of the chapter, for example, what we were actually describing was their total cash and cash equivalents.

The distinction between liquidity management and cash management is straightforward. Liquidity management concerns the optimal quantity of liquid assets a firm should have on hand, and it is one particular aspect of the current asset management policies we discussed in our previous chapter. Cash management is much more closely related to optimizing mechanisms for collecting and disbursing cash, and it is this subject that we primarily focus on in this chapter.

Concept Questions

- 19.1a** What is the transaction motive, and how does it lead firms to hold cash?
- 19.1b** What is the cost to the firm of holding excess cash?

19.2 Understanding Float

As you no doubt know, the amount of money you have according to your checkbook can be very different from the amount of money that your bank thinks you have. The reason is that some of the checks you have written haven't yet been presented to the bank for payment. The same thing is true for a business. The cash balance that a firm shows on its books is called the firm's *book*, or *ledger*, *balance*. The balance shown in its bank account as available to spend is called its *available*, or *collected*, *balance*. The difference between the available balance and the ledger balance, called the **float**, represents the net effect of checks in the process of *clearing* (moving through the banking system).

float

The difference between book cash and bank cash, representing the net effect of checks in the process of clearing.

DISBURSEMENT FLOAT

Checks written by a firm generate *disbursement float*, causing a decrease in the firm's book balance but no change in its available balance. For example, suppose General Mechanics, Inc. (GMI), currently has \$100,000 on deposit with its bank. On June 8, it buys some raw materials and pays with a check for \$100,000. The company's book balance is immediately reduced by \$100,000 as a result.

GMI's bank will not find out about this check until it is presented to GMI's bank for payment on, say, June 14. Until the check is presented, the firm's available balance is

greater than its book balance by \$100,000. In other words, before June 8, GMI has a zero float:

$$\begin{aligned}\text{Float} &= \text{Firm's available balance} - \text{Firm's book balance} \\ &= \$100,000 - 100,000 \\ &= \$0\end{aligned}$$

GMI's position from June 8 to June 14 is:

$$\begin{aligned}\text{Disbursement float} &= \text{Firm's available balance} - \text{Firm's book balance} \\ &= \$100,000 - 0 \\ &= \$100,000\end{aligned}$$

While the check is clearing, GMI has a balance with the bank of \$100,000. It can obtain the benefit of this cash during this period. For example, the available balance could be temporarily invested in marketable securities and earn some interest. We will return to this subject a little later.

COLLECTION FLOAT AND NET FLOAT

Checks received by the firm create *collection float*. Collection float increases book balances but does not immediately change available balances. Suppose GMI receives a check from a customer for \$100,000 on October 8. Assume, as before, that the company has \$100,000 deposited at its bank and a zero float. It deposits the check and increases its book balance by \$100,000 to \$200,000. However, the additional cash is not available to GMI until its bank has presented the check to the customer's bank and received \$100,000. This will occur on, say, October 14. In the meantime, the cash position at GMI will reflect a collection float of \$100,000. We can summarize these events. Before October 8, GMI's position is:

$$\begin{aligned}\text{Float} &= \text{Firm's available balance} - \text{Firm's book balance} \\ &= \$100,000 - 100,000 \\ &= \$0\end{aligned}$$

GMI's position from October 8 to October 14 is:

$$\begin{aligned}\text{Collection float} &= \text{Firm's available balance} - \text{Firm's book balance} \\ &= \$100,000 - 200,000 \\ &= -\$100,000\end{aligned}$$

In general, a firm's payment (disbursement) activities generate disbursement float, and its collection activities generate collection float. The net effect—that is, the sum of the total collection and disbursement floats—is the net float. The net float at a point in time is the overall difference between the firm's available balance and its book balance. If the net float is positive, then the firm's disbursement float exceeds its collection float, and its available balance exceeds its book balance. If the available balance is less than the book balance, then the firm has a net collection float.

A firm should be concerned with its net float and available balance more than with its book balance. If a financial manager knows that a check written by the company will not clear for several days, that manager will be able to keep a lower cash balance at the bank than might be possible otherwise. This can generate a great deal of money.

For example, take the case of Walmart. The average daily sales of Walmart are about \$1.32 billion. If Walmart's collections could be sped up by a single day, then the company could free up \$1.32 billion for investing. At a relatively modest .01 percent daily rate, the interest earned would be on the order of \$132,000 *per day*.

EXAMPLE 19.1**Staying Afloat**

Suppose you have \$5,000 on deposit. One day, you write a check for \$1,000 to pay for books, and you deposit \$2,000. What are your disbursement, collection, and net floats?

After you write the \$1,000 check, you show a balance of \$4,000 on your books, but the bank shows \$5,000 while the check is clearing. The difference is a disbursement float of \$1,000.

After you deposit the \$2,000 check, you show a balance of \$6,000. Your available balance doesn't rise until the check clears. This results in a collection float of -\$2,000. Your net float is the sum of the collection and disbursement floats, or -\$1,000.

Overall, you show \$6,000 on your books. The bank shows a \$7,000 balance, but only \$5,000 is available because your deposit has not been cleared. The discrepancy between your available balance and your book balance is the net float (-\$1,000), and it is bad for you. If you write another check for \$5,500, there may not be sufficient available funds to cover it, and it might bounce. This is why financial managers have to be more concerned with available balances than book balances.

FLOAT MANAGEMENT

For a real-world example of float management services, visit www.carreker.fiserv.com.

Float management involves controlling the collection and disbursement of cash. The objective in cash collection is to speed up collections and reduce the lag between the time customers pay their bills and the time the cash becomes available. The objective in cash disbursement is to control payments and minimize the firm's costs associated with making payments.

Total collection or disbursement times can be broken down into three parts: Mailing time, processing delay, and availability delay:

1. *Mailing time* is the part of the collection and disbursement process during which checks are trapped in the postal system.
2. *Processing delay* is the time it takes the receiver of a check to process the payment and deposit it in a bank for collection.
3. *Availability delay* refers to the time required to clear a check through the banking system.

Speeding up collections involves reducing one or more of these components. Slowing disbursements involves increasing one of them. We will describe some procedures for managing collection and disbursement times later. First, we need to discuss how float is measured.

Measuring Float The size of the float depends on both the dollars and the time delay involved. Suppose you mail a check for \$500 to another state each month. It takes five days in the mail for the check to reach its destination (the mailing time) and one day for the recipient to get over to the bank (the processing delay). The recipient's bank holds out-of-state checks for three days (availability delay). The total delay is $5 + 1 + 3 = 9$ days.

In this case, what is your average daily disbursement float? There are two equivalent ways of calculating the answer. First, you have a \$500 float for nine days, so we say that the total float is $9 \times \$500 = \$4,500$. Assuming 30 days in the month, the average daily float is $\$4,500/30 = \150 .

Alternatively, your disbursement float is \$500 for 9 days out of the month and zero the other 21 days (again assuming 30 days in a month). Your average daily float is:

$$\begin{aligned}
 \text{Average daily float} &= (9 \times \$500 + 21 \times 0)/30 \\
 &= 9/30 \times \$500 + 21/30 \times 0 \\
 &= \$4,500/30 \\
 &= \$150
 \end{aligned}$$

This means that, on an average day, your book balance is \$150 less than your available balance, representing a \$150 average disbursement float.

Things are only a little more complicated when there are multiple disbursements or receipts. To illustrate, suppose Concepts, Inc., receives two items each month as follows:

<u>Amount</u>	<u>Processing and availability delay</u>	<u>Total float</u>
Item 1: \$5,000,000	× 9	= \$45,000,000
Item 2: \$3,000,000	× 5	= \$15,000,000
Total \$8,000,000		\$60,000,000

The average daily float is equal to:

$$\begin{aligned}\text{Average daily float} &= \frac{\text{Total float}}{\text{Total days}} \\ &= \frac{\$60 \text{ million}}{30} = \$2 \text{ million}\end{aligned}$$

19.1

So, on an average day, there is \$2 million that is uncollected and unavailable.

Another way to see this is to calculate the average daily receipts and multiply by the weighted average delay. Average daily receipts are:

$$\text{Average daily receipts} = \frac{\text{Total receipts}}{\text{Total days}} = \frac{\$8 \text{ million}}{30} = \$266,666.67$$

Of the \$8 million total receipts, \$5 million, or $\frac{5}{8}$ of the total, is delayed for nine days. The other $\frac{3}{8}$ is delayed for five days. The weighted average delay is thus:

$$\begin{aligned}\text{Weighted average delay} &= (5/8) \times 9 \text{ days} + (3/8) \times 5 \text{ days} \\ &= 5.625 \text{ days} + 1.875 \text{ days} = 7.50 \text{ days}\end{aligned}$$

The average daily float is:

$$\begin{aligned}\text{Average daily float} &= \text{Average daily receipts} \times \text{Weighted average delay} \\ &= \$266,666.67 \times 7.50 \text{ days} = \$2 \text{ million}\end{aligned}$$

19.2

Some Details In measuring float, there is an important difference to note between collection and disbursement float. We defined *float* as the difference between the firm's available cash balance and its book balance. With a disbursement, the firm's book balance goes down when the check is *mailed*, so the mailing time is an important component in disbursement float. With a collection, the firm's book balance isn't increased until the check is *received*, so mailing time is not a component of collection float.

This doesn't mean that mailing time is not important. The point is that when collection *float* is calculated, mailing time should not be considered. As we will discuss, when total collection *time* is considered, the mailing time is a crucial component.

Also, when we talk about availability delay, how long it actually takes a check to clear isn't really crucial. What matters is how long we must wait before the bank grants availability—that is, use of the funds. Banks actually use availability schedules to determine how long a check is held based on time of deposit and other factors. Beyond this, availability delay can be a matter of negotiation between the bank and a customer. In a similar vein, for outgoing checks, what matters is the date our account is debited, not when the recipient is granted availability.

Cost of the Float The basic cost of collection float to the firm is the opportunity cost of not being able to use the cash. At a minimum, the firm could earn interest on the cash if it were available for investing.

FIGURE 19.1**Buildup of the Float**

	Day	1	2	3	4	5	...
Beginning float	\$ 0	\$ 1,000	\$ 2,000	\$ 3,000	\$ 3,000	\$ 3,000	...
Checks received	1,000	1,000	1,000	1,000	1,000	1,000	...
Checks cleared (cash available)	- 0	- 0	- 0	- 1,000	- 1,000	- 1,000	...
Ending float	<u><u>\$1,000</u></u>	<u><u>\$2,000</u></u>	<u><u>\$3,000</u></u>	<u><u>\$3,000</u></u>	<u><u>\$3,000</u></u>	<u><u>\$3,000</u></u>	...

FIGURE 19.2**Effect of Eliminating the Float**

	Day	t	t + 1	t + 2	...
Beginning float	\$3,000	\$ 0	\$ 0	\$ 0	...
Checks received	1,000	1,000	1,000	1,000	...
Checks cleared (cash available)	- 4,000	- 1,000	- 1,000	- 1,000	...
Ending float	<u><u>\$ 0</u></u>	<u><u>\$ 0</u></u>	<u><u>\$ 0</u></u>	<u><u>\$ 0</u></u>	...

Suppose the Lambo Corporation has average daily receipts of \$1,000 and a weighted average delay of three days. The average daily float is $3 \times \$1,000 = \$3,000$. This means that, on a typical day, there is \$3,000 that is not earning interest. Suppose Lambo could eliminate the float entirely. What would be the benefit? If it costs \$2,000 to eliminate the float, what is the NPV of doing so?

Figure 19.1 illustrates the situation for Lambo. Suppose Lambo starts with a zero float. On a given day, Day 1, Lambo receives and deposits a check for \$1,000. The cash will become available three days later on Day 4. At the end of the day on Day 1, the book balance is \$1,000 more than the available balance, so the float is \$1,000. On Day 2, the firm receives and deposits another check. It will collect this check (i.e., the cash will become available) three days later on Day 5. At the end of Day 2, there are two uncollected checks, and the books show a \$2,000 balance. The bank still shows a zero available balance; so the float is \$2,000. The same sequence occurs on Day 3, and the float rises to a total of \$3,000.

On Day 4, Lambo again receives and deposits a check for \$1,000. It also collects \$1,000 from the Day 1 check. The change in book balance and the change in available balance are identical, +\$1,000; so the float stays at \$3,000. The same thing happens every day after Day 4; the float therefore stays at \$3,000 forever.¹

Figure 19.2 illustrates what happens if the float is eliminated entirely on some Day t in the future. After the float is eliminated, daily receipts are still \$1,000. The firm collects the same day because the float is eliminated, so daily collections are also still \$1,000. As Figure 19.2 illustrates, the only change occurs the first day. On that day, as usual, Lambo collects \$1,000 from the sale made three days before. Because the float is gone, it also collects on the sales made two days before, one day before, and that same day, for an additional \$3,000. Total collections on Day t are \$4,000 instead of \$1,000.

What we see is that Lambo generates an extra \$3,000 on Day t by eliminating the float. On every subsequent day, Lambo receives \$1,000 in cash just as it did before the float was eliminated. Thus, the only change in the firm's cash flows from eliminating the float is

¹This permanent float is sometimes called the *steady-state float*.

this extra \$3,000 that comes in immediately. No other cash flows are affected, so Lambo is \$3,000 richer.

In other words, the PV of eliminating the float is equal to the total float. Lambo could pay this amount out as a dividend, invest it in interest-bearing assets, or do anything else with it. If it costs \$2,000 to eliminate the float, then the NPV is $\$3,000 - \$2,000 = \$1,000$; so Lambo should do it.

Reducing the Float: Part I

EXAMPLE 19.2

Instead of eliminating the float, suppose Lambo can reduce it to one day. What is the maximum Lambo should be willing to pay for this?

If Lambo can reduce the float from three days to one day, then the amount of the float will fall from \$3,000 to \$1,000. From our discussion immediately preceding, we see right away that the PV of doing this is just equal to the \$2,000 float reduction. Lambo should be willing to pay up to \$2,000.

Reducing the Float: Part II

EXAMPLE 19.3

Look back at Example 19.2. A large bank is willing to provide the float reduction service for \$175 per year, payable at the end of each year. The relevant discount rate is 8 percent. Should Lambo hire the bank? What is the NPV of the investment? How do you interpret this discount rate? What is the most per year that Lambo should be willing to pay?

The PV to Lambo is still \$2,000. The \$175 would have to be paid out every year forever to maintain the float reduction; so the cost is perpetual, and its PV is $\$175/0.08 = \$2,187.50$. The NPV is $\$2,000 - \$2,187.50 = -\$187.50$; therefore, the service is not a good deal.

Ignoring the possibility of bounced checks, the discount rate here corresponds most closely to the cost of short-term borrowing. The reason is that Lambo could borrow \$1,000 from the bank every time a check was deposited and pay it back three days later. The cost would be the interest that Lambo would have to pay.

The most Lambo would be willing to pay is whatever charge results in an NPV of zero. This zero NPV occurs when the \$2,000 benefit exactly equals the PV of the costs—that is, when $\$2,000 = C/0.08$, where C is the annual cost. Solving for C, we find that $C = .08 \times \$2,000 = \160 per year.

Ethical and Legal Questions The cash manager must work with collected bank cash balances and not the firm's book balance (which reflects checks that have been deposited but not collected). If this is not done, a cash manager could be drawing on uncollected cash as a source of funds for short-term investing. Most banks charge a penalty rate for the use of uncollected funds. However, banks may not have good enough accounting and control procedures to be fully aware of the use of uncollected funds. This raises some ethical and legal questions for the firm.

For example, in May 1985, E.F. Hutton (a large investment bank) pleaded guilty to 2,000 charges of mail and wire fraud in connection with a scheme the firm had operated from 1980 to 1982. E.F. Hutton employees had written checks totaling hundreds of millions of dollars against uncollected cash. The proceeds had then been invested in short-term money market assets. This type of systematic overdrafting of accounts (or check *kiting*, as it is sometimes called) is neither legal nor ethical and is apparently not a widespread practice among corporations. Also, the particular inefficiencies in the banking system that Hutton was exploiting have been largely eliminated.

For its part, E.F. Hutton paid a \$2 million fine, reimbursed the government (the U.S. Department of Justice) \$750,000, and reserved an additional \$8 million for restitution to defrauded banks. We should note that the key issue in the case against Hutton was not its float management per se, but, rather, its practice of writing checks for no economic reason other than to exploit float.

Despite stiff penalties for check kiting, the practice apparently continues. For example, in August 2016, a Michigan woman admitted to a check kiting scheme involving more than \$145 million in checks. This fraud cost one financial institution more than \$1.8 million.

ELECTRONIC DATA INTERCHANGE AND CHECK 21: THE END OF FLOAT?

Electronic data interchange (EDI) is a general term that refers to the growing practice of direct, electronic information exchange between all types of businesses. One important use of EDI, often called *financial EDI or FEDI*, is to electronically transfer financial information and funds between parties, thereby eliminating paper invoices, paper checks, mailing, and handling. It is now possible to arrange to have your checking account directly debited each month to pay many types of bills, and corporations now routinely directly deposit paychecks into employee accounts. More generally, EDI allows a seller to send a bill electronically to a buyer, thereby avoiding the mail. The buyer can then authorize payment, which also occurs electronically. Its bank then transfers the funds to the seller's account at a different bank. The net effect is that the length of time required to initiate and complete a business transaction is shortened considerably, and much of what we normally think of as float is sharply reduced or eliminated. As the use of FEDI increases (which it will), float management will evolve to focus much more on issues surrounding computerized information exchange and funds transfers.

One of the drawbacks of EDI (and FEDI) is that it is expensive and complex to set up. With the growth of the Internet, a new form of EDI has emerged: Internet e-commerce. For example, networking giant Cisco Systems books millions in orders each day on its website from resellers around the world. Firms are also linking to critical suppliers and customers via “extranets,” which are business networks that extend a company’s internal network. Because of security concerns and lack of standardization, don’t look for e-commerce and extranets to eliminate the need for EDI anytime soon. In fact, these are complementary systems that will most likely be used in tandem as the future unfolds.

On October 29, 2004, the Check Clearing Act for the 21st Century, also known as Check 21, took effect. Before Check 21, a bank receiving a check was required to send the physical check to the customer’s bank before payment could be made. Now a bank can transmit an electronic image of the check to the customer’s bank and receive payment immediately. Previously, an out-of-state check might take three days to clear. But with Check 21, the clearing time is typically one day; and often a check can clear the same day it is written. Check 21 has significantly reduced float.

Concept Questions

- 19.2a** Which would a firm be most interested in reducing, collection or disbursement float? Why?
- 19.2b** How is daily average float calculated?
- 19.2c** What is the benefit from reducing or eliminating float?

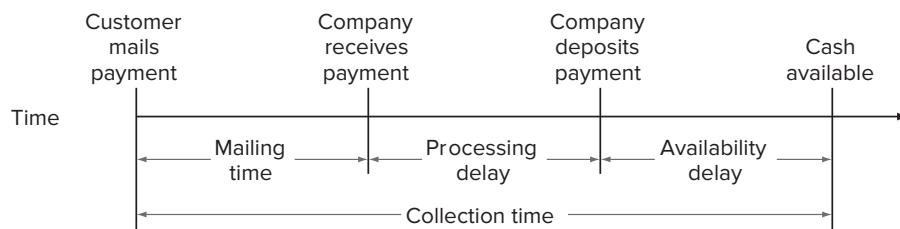
Cash Collection and Concentration

19.3

From our previous discussion, we know that collection delays work against the firm. All other things being the same, a firm will adopt procedures to speed up collections and thereby decrease collection times. In addition, even after cash is collected, firms need procedures to funnel, or concentrate, that cash where it can be best used. We discuss some common collection and concentration procedures next.

COMPONENTS OF COLLECTION TIME

Based on our previous discussion, we can depict the basic parts of the cash collection process as follows. The total time in this process is made up of mailing time, check-processing delay, and the bank's availability delay.



The amount of time that cash spends in each part of the cash collection process depends on where the firm's customers and banks are located and how efficient the firm is in collecting cash.

CASH COLLECTION

How a firm collects from its customers depends in large part on the nature of the business. The simplest case would be a business such as a restaurant chain. Most of its customers will pay with cash, check, or credit card at the point of sale (this is called *over-the-counter collection*), so there is no problem with mailing delay. Normally, the funds will be deposited in a local bank, and the firm will have some means (discussed later) of gaining access to the funds.

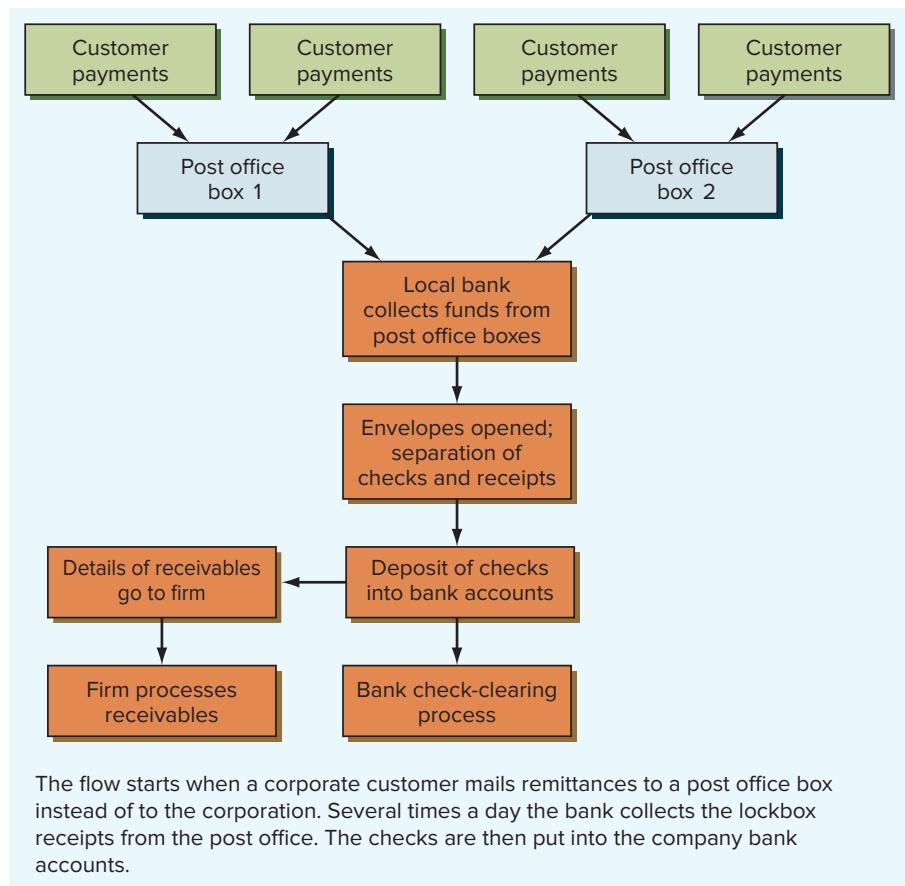
When some or all of the payments a company receives are checks that arrive through the mail, all three components of collection time become relevant. The firm may choose to have all the checks mailed to one location; more commonly, the firm might have a number of different mail collection points to reduce mailing times. Also, the firm may run its collection operation itself or might hire an outside firm that specializes in cash collection. We discuss these issues in more detail in the following sections.

Other approaches to cash collection exist. One that is becoming more common is the preauthorized payment arrangement. With this arrangement, the payment amounts and payment dates are fixed in advance. When the agreed-upon date arrives, the amount is automatically transferred from the customer's bank account to the firm's bank account, which sharply reduces or even eliminates collection delays. The same approach is used by firms that have online terminals, meaning that when a sale is rung up, the money is immediately transferred to the firm's accounts.

LOCKBOXES

When a firm receives its payments by mail, it must decide where the checks will be mailed and how the checks will be picked up and deposited. Careful selection of the number and

FIGURE 19.3
Overview of Lockbox Processing



lockboxes

Special post office boxes set up to intercept and speed up accounts receivable payments.

locations of collection points can greatly reduce collection times. Many firms use special post office boxes called **lockboxes** to intercept payments and speed cash collection.

Figure 19.3 illustrates a lockbox system. The collection process is started by customers mailing their checks to a post office box instead of sending them to the firm. The lockbox is maintained by a local bank. A large corporation may actually maintain more than 20 lockboxes around the country.

In the typical lockbox system, the local bank collects the lockbox checks several times a day. The bank deposits the checks directly into the firm's account. Details of the operation are recorded (in some computer-readable form) and sent to the firm.

A lockbox system reduces mailing time because checks are received at a nearby post office instead of at corporate headquarters. Lockboxes also reduce the processing time because the corporation doesn't have to open the envelopes and deposit checks for collection. In all, a bank lockbox system should enable a firm to get its receipts processed, deposited, and cleared faster than if it were to receive checks at its headquarters and deliver them itself to the bank for deposit and clearing.

Some firms have turned to what are called “electronic lockboxes” as an alternative to traditional lockboxes. In one version of an electronic lockbox, customers use the telephone or the Internet to access their account—say, their credit card account at a bank—review their bill, and authorize payment without paper ever having changed hands on either end of the transaction. Clearly, an electronic lockbox system is far superior to traditional bill payment methods, at least from the biller’s perspective. Look for systems like this to continue to grow in popularity.

CASH CONCENTRATION

As we discussed earlier, a firm will typically have a number of cash collection points; as a result, cash collections may end up in many different banks and bank accounts. From here, the firm needs procedures to move the cash into its main accounts. This is called **cash concentration**. By routinely pooling its cash, the firm greatly simplifies its cash management by reducing the number of accounts that must be tracked. Also, by having a larger pool of funds available, a firm may be able to negotiate or otherwise obtain a better rate on any short-term investments.

In setting up a concentration system, firms will typically use one or more *concentration banks*. A concentration bank pools the funds obtained from local banks contained within some geographic region. Concentration systems are often used in conjunction with lockbox systems. Figure 19.4 illustrates how an integrated cash collection and cash concentration system might look. As Figure 19.4 illustrates, a key part of the cash collection and concentration process is the transfer of funds to the concentration bank. There are several options available for accomplishing this transfer. The cheapest is a *depository transfer check* (DTC), which is a preprinted check that usually needs no signature and is valid only for transferring funds between specific accounts within the *same* firm. The money becomes available one to two days later. *Automated clearinghouse* (ACH) transfers are basically electronic versions of paper checks. These may be more expensive, depending on the circumstances, but the funds are available the next day. The most expensive means

cash concentration

The practice of and procedures for moving cash from multiple banks into the firm's main accounts.

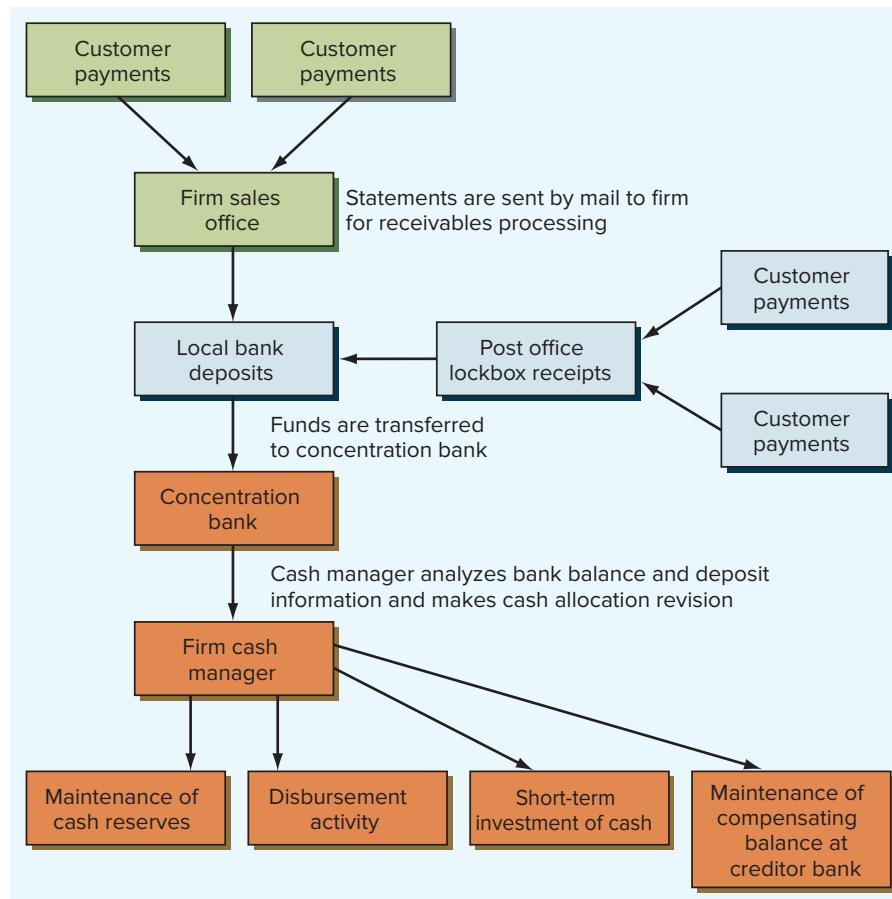


FIGURE 19.4

Lockboxes and Concentration Banks in a Cash Management System



For current info about cash management—especially for international issues—visit Global Treasury News at www.gtnews.com.

of transfer are *wire transfers*, which provide same-day availability. Which approach a firm will choose depends on the number and size of payments. A typical ACH transfer might be \$200, whereas a typical wire transfer would be several million dollars. Firms with a large number of collection points and relatively small payments will choose the cheaper route, whereas firms that receive smaller numbers of relatively large payments may choose more expensive procedures.

ACCELERATING COLLECTIONS: AN EXAMPLE

The decision of whether or not to use a bank cash management service incorporating lock-boxes and concentration banks depends on where a firm's customers are located and the speed of the U.S. postal system. Suppose Atlantic Corporation, located in Philadelphia, is considering a lockbox system. Its collection delay is currently eight days.

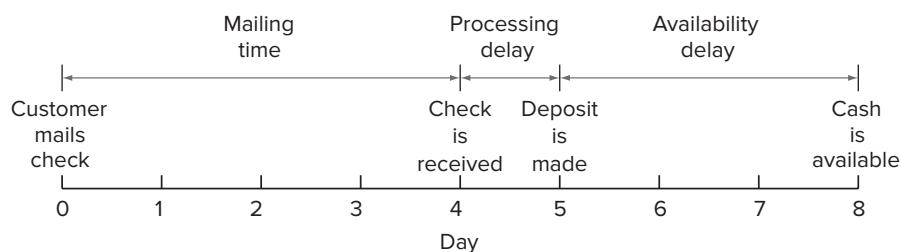
Atlantic does business in the southwestern part of the country (New Mexico, Arizona, and California). The proposed lockbox system would be located in Los Angeles and operated by Pacific Bank. Pacific Bank has analyzed Atlantic's cash-gathering system and has concluded that it can decrease collection time by two days. Specifically, the bank has come up with the following information on the proposed lockbox system:

$$\begin{aligned}
 \text{Reduction in mailing time} &= 1.0 \text{ day} \\
 \text{Reduction in clearing time} &= .5 \text{ day} \\
 \text{Reduction in firm processing time} &= \underline{.5 \text{ day}} \\
 \text{Total} &= 2.0 \text{ days}
 \end{aligned}$$

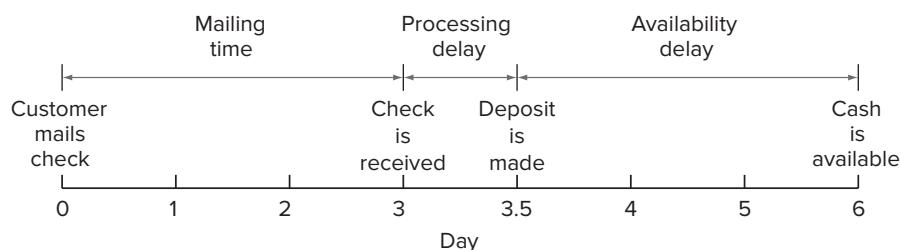
The following is also known:

$$\begin{aligned}
 \text{Daily interest on Treasury bills} &= .025\% \\
 \text{Average number of daily payments to lockboxes} &= 2,000 \\
 \text{Average size of payment} &= \$600
 \end{aligned}$$

The cash flows for the current collection operation are shown in the following cash flow time chart:



The cash flows for the lockbox collection operation will be as follows:



Pacific Bank has agreed to operate this lockbox system for a fee of 25 cents per check processed. Should Atlantic give the go-ahead?

We first need to determine the benefit of the system. The average daily collections from the southwestern region are \$1.2 million ($= 2,000 \times \600). The collection time will be decreased by two days, so the lockbox system will increase the collected bank balance by $\$1.2 \text{ million} \times 2 = \2.4 million . In other words, the lockbox system releases \$2.4 million to the firm by reducing processing, mailing, and clearing time by two days. From our earlier discussion, we know that this \$2.4 million is the PV of the proposal.

To calculate the NPV, we need to determine the PV of the costs. There are several different ways to proceed. First, at 2,000 checks per day and \$.25 per check, the daily cost is \$500. This cost will be incurred every day forever. At an interest rate of .025 percent per day, the PV is therefore $\$500/.00025 = \2 million . The NPV is $\$2.4 \text{ million} - 2 \text{ million} = \$400,000$, and the system appears to be desirable.

Alternatively, Atlantic could invest the \$2.4 million at .025 percent per day. The interest earned would be $\$2.4 \text{ million} \times .00025 = \600 per day . The cost of the system is \$500 per day; so, running it obviously generates a profit in the amount of \$100 per day. The PV of \$100 per day forever is $\$100/.00025 = \$400,000$, just as we had before.

Finally, each check is for \$600 and is available two days sooner if the system is used. The interest on \$600 for two days is $2 \times \$600 \times .00025 = \$.30$. The cost is 25 cents per check, so Atlantic makes a nickel ($= \$.30 - .25$) on every check. With 2,000 checks per day, the profit is $\$.05 \times 2,000 \text{ checks} = \100 per day , as we calculated.

Accelerating Collections

EXAMPLE 19.4

In our example concerning Atlantic Corporation's proposed lockbox system, suppose Pacific Bank wants a \$20,000 fixed fee (paid annually) in addition to the 25 cents per check. Is the system still a good idea?

To answer, we need to calculate the PV of the fixed fee. The daily interest rate is .025 percent. The annual rate is therefore $1.00025^{365} - 1 = .09553$, or 9.553%. The PV of the fixed fee (which is paid each year forever) is $\$20,000/.09553 = \$209,358$. Because the NPV without the fee is \$400,000, the NPV with the fee is $\$400,000 - 209,358 = \$190,642$. It's still a good idea.

Concept Questions

- 19.3a** What is a lockbox? What purpose does it serve?
- 19.3b** What is a concentration bank? What purpose does it serve?

Managing Cash Disbursements

19.4

From the firm's point of view, disbursement float is desirable, so the goal in managing disbursement float is to slow down disbursements. To do this, the firm may develop strategies to *increase* mail float, processing float, and availability float on the checks it writes. Beyond this, firms have developed procedures for minimizing cash held for payment purposes. We discuss the most common of these in this section.



For a free cash budgeting spreadsheet, go to finance.toolkit.com.

INCREASING DISBURSEMENT FLOAT

As we have seen, slowing down payments comes from the time involved in mail delivery, check processing, and collection of funds. Disbursement float can be increased by writing

a check on a geographically distant bank. For example, a New York supplier might be paid with checks drawn on a Los Angeles bank. This will increase the time required for the checks to clear through the banking system. Mailing checks from remote post offices is another way firms slow down disbursement.

Tactics for maximizing disbursement float are debatable on both ethical and economic grounds. First, as we discuss in some detail in the next chapter, payment terms frequently offer a substantial discount for early payment. The discount is usually much larger than any possible savings from “playing the float game.” In such cases, increasing mailing time will be of no benefit if the recipient dates payments based on the date received (as is common) as opposed to the postmark date.

Beyond this, suppliers are not likely to be fooled by attempts to slow down disbursements. The negative consequences of poor relations with suppliers can be costly. In broader terms, intentionally delaying payments by taking advantage of mailing times or unsophisticated suppliers may amount to avoiding paying bills when they are due—an unethical business procedure.

CONTROLLING DISBURSEMENTS

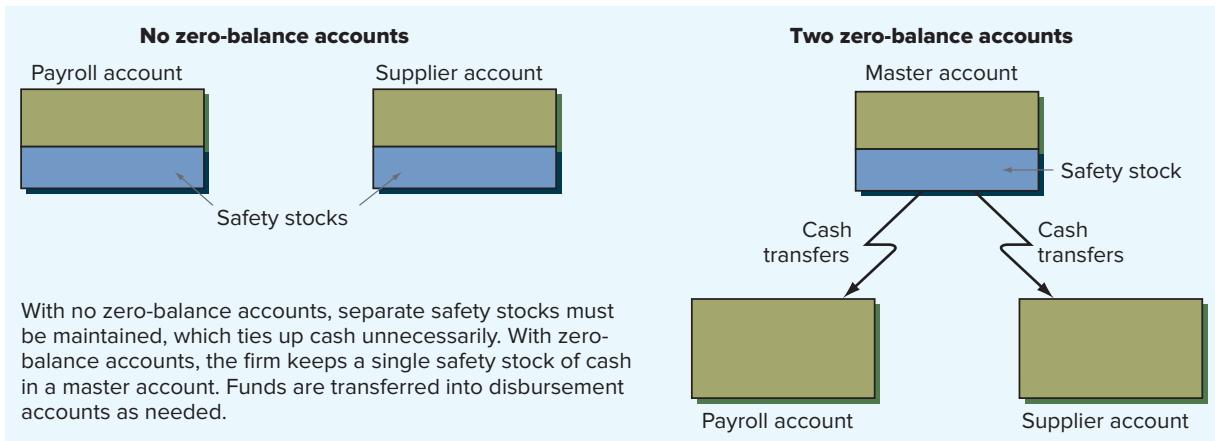
We have seen that maximizing disbursement float is probably poor business practice. However, a firm will still wish to tie up as little cash as possible in disbursements. Firms have therefore developed systems for efficiently managing the disbursement process. The general idea in such systems is to have no more than the minimum amount necessary to pay bills on deposit in the bank. We discuss some approaches to accomplishing this goal next.

zero-balance account

A disbursement account in which the firm maintains a zero balance, transferring funds in from a master account only as needed to cover checks presented for payment.

Zero-Balance Accounts With a **zero-balance account** system, the firm, in cooperation with its bank, maintains a master account and a set of subaccounts. When a check written on one of the subaccounts must be paid, the necessary funds are transferred in from the master account. Figure 19.5 illustrates how such a system might work. In this case, the firm maintains two disbursement accounts, one for suppliers and one for payroll. As shown, if the firm does not use zero-balance accounts, then each of these accounts must have a safety stock of cash to meet unanticipated demands. If the firm does use zero-balance accounts, then it can keep one safety stock in a master account and transfer the funds to the two subsidiary accounts as needed. The key is that the total amount of cash held as a buffer is smaller under the zero-balance arrangement, which frees up cash to be used elsewhere.

FIGURE 19.5 Zero-Balance Accounts



Controlled Disbursement Accounts With a **controlled disbursement account** system, almost all payments that must be made in a given day are known in the morning. The bank informs the firm of the total, and the firm transfers (usually by wire) the amount needed.

Concept Questions

- 19.4a** Is maximizing disbursement float a sound business practice?
- 19.4b** What is a zero-balance account? What is the advantage of such an account?

controlled disbursement account

A disbursement account to which the firm transfers an amount that is sufficient to cover demands for payment.

Investing Idle Cash

19.5

If a firm has a temporary cash surplus, it can invest in short-term securities. As we have mentioned at various times, the market for short-term financial assets is called the *money market*. The maturity of short-term financial assets that trade in the money market is one year or less.

Most large firms manage their own short-term financial assets, carrying out transactions through banks and dealers. Some large firms and many small firms use money market mutual funds. These are funds that invest in short-term financial assets for a management fee. The management fee is compensation for the professional expertise and diversification provided by the fund manager.

Among the many money market mutual funds, some specialize in corporate customers. In addition, banks offer arrangements in which the bank takes all excess available funds at the close of each business day and invests them for the firm.

TEMPORARY CASH SURPLUSES

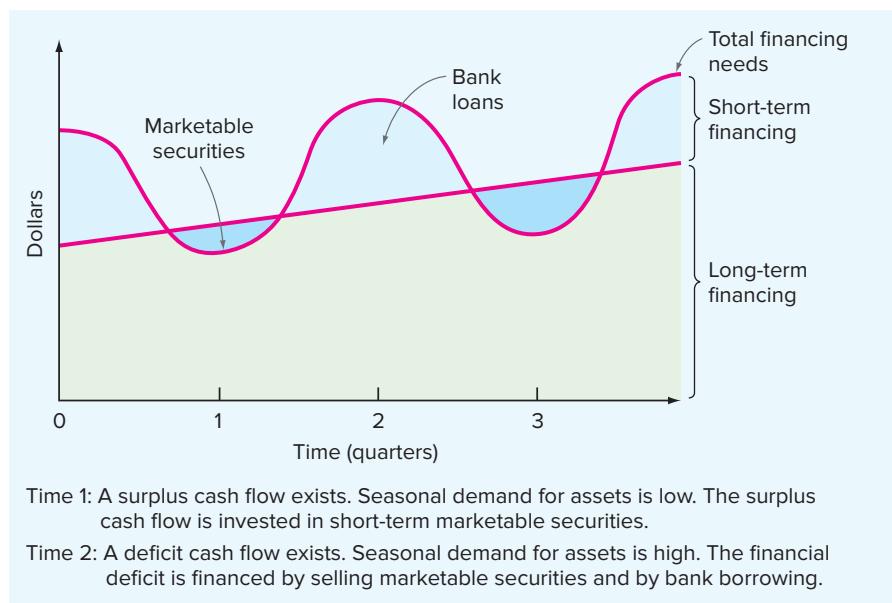
Firms have temporary cash surpluses for various reasons. Two of the most important are the financing of seasonal or cyclical activities of the firm and the financing of planned or possible expenditures.

Seasonal or Cyclical Activities Some firms have a predictable cash flow pattern. They have surplus cash flows during part of the year and deficit cash flows the rest of the year. For example, Toys “R” Us, a retail toy firm, has a seasonal cash flow pattern influenced by the holiday season.

A firm such as Toys “R” Us may buy marketable securities when surplus cash flows occur and sell marketable securities when deficits occur. Of course, bank loans are another short-term financing device. The use of bank loans and marketable securities to meet temporary financing needs is illustrated in Figure 19.6. In this case, the firm is following a compromise working capital policy in the sense we discussed in the previous chapter.

Planned or Possible Expenditures Firms frequently accumulate temporary investments in marketable securities to provide the cash for a plant construction program, dividend payment, or other large expenditure. Thus, firms may issue bonds and stocks before the cash is needed, investing the proceeds in short-term marketable securities and then selling the securities to finance the expenditures. Also, firms may face the possibility of having to make a large cash outlay. An obvious example would involve the possibility of losing a large lawsuit. Firms may build up cash surpluses against such a contingency.

FIGURE 19.6
Seasonal Cash Demands



CHARACTERISTICS OF SHORT-TERM SECURITIES

Given that a firm has some temporarily idle cash, a variety of short-term securities are available for investing. The most important characteristics of these short-term marketable securities are their maturity, default risk, marketability, and taxability.

Maturity From Chapter 7, we know that for a given change in the level of interest rates, the prices of longer-maturity securities will change more than those of shorter-maturity securities. As a consequence, firms that invest in long-term securities are accepting greater risk than firms that invest in securities with short-term maturities.

We called this type of risk *interest rate risk*. Firms often limit their investments in marketable securities to those maturing in less than 90 days to avoid the risk of losses in value from changing interest rates. Of course, the expected return on securities with short-term maturities is usually less than the expected return on securities with longer maturities.

Default Risk *Default risk* refers to the probability that interest and principal will not be paid in the promised amounts on the due dates (or will not be paid at all). In Chapter 7, we observed that various financial reporting agencies, such as Moody's Investors Service and Standard and Poor's, compile and publish ratings of various corporate and other publicly held securities. These ratings are connected to default risk. Of course, some securities have negligible default risk, such as U.S. Treasury bills. Given the purposes of investing idle corporate cash, firms typically avoid investing in marketable securities with significant default risk.

Marketability *Marketability* refers to how easy it is to convert an asset to cash; so marketability and liquidity mean much the same thing. Some money market instruments are much more marketable than others. At the top of the list are U.S. Treasury bills, which can be bought and sold very cheaply and very quickly.

Taxes Interest earned on money market securities that are not some kind of government obligation (either federal or state) is taxable at the local, state, and federal levels. U.S. Treasury obligations such as T-bills are exempt from state taxation, but other government-backed debt is not. Municipal securities are exempt from federal taxes, but they may be taxed at the state level.

SOME DIFFERENT TYPES OF MONEY MARKET SECURITIES

Money market securities are generally highly marketable and short-term. They usually have low risk of default. They are issued by the U.S. government (for example, U.S. Treasury bills), domestic and foreign banks (for example, certificates of deposit), and business corporations (for example, commercial paper). There are many types in all, and we illustrate only a few of the most common here.

U.S. Treasury bills are obligations of the U.S. government that mature in 30, 90, or 180 days. Bills are sold by auction every week.

Short-term tax-exempts are short-term securities issued by states, municipalities, local housing agencies, and urban renewal agencies. Because these are all considered municipal securities, they are exempt from federal taxes. RANs, BANs, and TANs are revenue, bond, and tax anticipation notes, respectively. In other words, they represent short-term borrowing by municipalities in anticipation of cash receipts.

Short-term tax-exempts have more default risk than U.S. Treasury issues and are less marketable. Because the interest is exempt from federal income tax, the pretax yield on tax-exempts is lower than that on comparable securities such as Treasury bills. Also, corporations face restrictions on holding tax-exempts as investments.

Commercial paper consists of short-term securities issued by finance companies, banks, and corporations. Typically, commercial paper is unsecured. Maturities range from a few weeks to 270 days.

There is no especially active secondary market in commercial paper. As a consequence, the marketability can be low; however, firms that issue commercial paper will often repurchase it directly before maturity. The default risk of commercial paper depends on the financial strength of the issuer. Moody's and S&P publish quality ratings for commercial paper. These ratings are similar to the bond ratings we discussed in Chapter 7.

Certificates of deposit (CDs) are short-term loans to commercial banks. The most common are jumbo CDs—those in excess of \$100,000. There are active markets in CDs of 3-month, 6-month, 9-month, and 12-month maturities.

Repurchase agreements (repos) are sales of government securities (for example, U.S. Treasury bills) by a bank or securities dealer with an agreement to repurchase. Typically, an investor buys some Treasury securities from a bond dealer and simultaneously agrees to sell them back at a later date at a specified higher price. Repurchase agreements usually involve a very short term—overnight to a few days.

A corporate stockholder receiving either common or preferred dividends is granted a 50 percent (or more) dividend exclusion (reduced from 70 percent or more in the 2017 Tax Cuts and Jobs Act). As a result, the relatively high dividend yields on preferred stock provide a strong incentive for investment. A problem is that the dividend is fixed with ordinary preferred stock, so the price can fluctuate more than is desirable in a short-term investment. Money market preferred stock (also known as auction rate preferred) features a floating dividend. The dividend is reset fairly often (usually every 49 days); so this type of preferred has much less price volatility than ordinary preferred, and it is a popular short-term investment.



Check out short-term rates
online at
www.bloomberg.com.

Concept Questions

- 19.5a** What are some reasons why firms find themselves with idle cash?
- 19.5b** What are some types of money market securities?
- 19.5c** Why are money market preferred stocks an attractive short-term investment?

19.6 Summary and Conclusions

In this chapter, we have examined cash and liquidity management. We saw the following:

1. A firm holds cash to conduct transactions and to compensate banks for the various services they render.
2. The difference between a firm's available balance and its book balance is the firm's net float. The float reflects the fact that some checks have not cleared and are uncollected. The financial manager must always work with collected cash balances and not with the company's book balance. To do otherwise is to use the bank's cash without the bank's knowing it, which raises ethical and legal questions.
3. The firm can make use of a variety of procedures to manage the collection and disbursement of cash in such a way as to speed up the collection of cash and slow down the payments. Some methods to speed up collection are the use of lockboxes, concentration banking, and wire transfers.
4. Because of seasonal and cyclical activities, to help finance planned expenditures, or as a contingency reserve, firms temporarily hold a cash surplus. The money market offers a variety of possible vehicles for "parking" this idle cash.

CONNECT TO FINANCE



connect[®]

If you are using *Connect Finance* in your course, get online to take a Practice Test, check out study tools, and find out where you need additional practice.

Can you answer the following Connect Quiz questions?

Section 19.1 Cash management is defined as _____.

Section 19.2 A firm probably has the most control over what components of collection float?

Section 19.3 What is the primary purpose of a lockbox?

CHAPTER REVIEW AND SELF-TEST PROBLEM

19.1 Float Measurement On a typical day, a firm writes checks totaling \$3,000. These checks clear in seven days. Simultaneously, the firm receives \$1,700. The cash is available in two days on average. Calculate the disbursement, collection, and net floats. How do you interpret the answer?

ANSWERS TO CHAPTER REVIEW AND SELF-TEST PROBLEM

19.1 The disbursement float is $7 \text{ days} \times \$3,000 = \$21,000$. The collection float is $2 \text{ days} \times (-\$1,700) = -\$3,400$. The net float is $\$21,000 + (-\$3,400) = \$17,600$. In other words, at any given time, the firm typically has uncashed checks outstanding of \$21,000. At the same time, it has uncollected receipts of \$3,400. Thus the firm's book balance is typically \$17,600 less than its available balance, for a positive \$17,600 net float.

CONCEPTS REVIEW AND CRITICAL THINKING QUESTIONS

1. **Cash Management [LO3]** Is it possible for a firm to have too much cash? Why would shareholders care if a firm accumulates large amounts of cash?
2. **Cash Management [LO3]** What options are available to a firm if it believes it has too much cash? How about too little?
3. **Agency Issues [LO3]** Are stockholders and creditors likely to agree on how much cash a firm should keep on hand?
4. **Motivations for Holding Cash [LO3]** In the chapter opening, we discussed the enormous cash positions of several companies. Why would firms such as these hold such large quantities of cash?
5. **Cash Management versus Liquidity Management [LO3]** What is the difference between cash management and liquidity management?
6. **Short-Term Investments [LO3]** Why is preferred stock with a dividend tied to short-term interest rates an attractive short-term investment for corporations with excess cash?
7. **Collection and Disbursement Floats [LO1]** Which would a firm prefer: A net collection float or a net disbursement float? Why?
8. **Float [LO1]** Suppose a firm has a book balance of \$2 million. On the bank's website, the cash manager finds out that the bank balance is \$2.5 million. What is the situation here? If this is an ongoing situation, what ethical dilemma arises?
9. **Short-Term Investments [LO3]** For each of the short-term marketable securities given here, provide an example of the potential disadvantages the investment has for meeting a corporation's cash management goals:
 - a. U.S. Treasury bills.
 - b. Ordinary preferred stock.
 - c. Negotiable certificates of deposit (NCDs).
 - d. Commercial paper.
 - e. Revenue anticipation notes.
 - f. Repurchase agreements.
10. **Agency Issues [LO3]** It is sometimes argued that excess cash held by a firm can aggravate agency problems (discussed in Chapter 1) and, more generally, reduce incentives for shareholder wealth maximization. How would you frame the issue here?
11. **Use of Excess Cash [LO3]** One option a firm usually has with any excess cash is to pay its suppliers more quickly. What are the advantages and disadvantages of this use of excess cash?
12. **Use of Excess Cash [LO3]** One option usually available to a firm with excess cash is to reduce the firm's outstanding debt. What are the advantages and disadvantages of this use of excess cash?
13. **Float [LO1]** An unfortunately common practice goes like this (warning: don't try this at home): Suppose you are out of money in your checking account; however, your local grocery store will, as a convenience to you as a customer, cash a check for you. So, you cash a check for \$200. Of course, this check will bounce unless you do something. To prevent this, you go to the grocery the next day and cash another check for \$200. You take this \$200 and deposit it. You repeat this process every day, and, in doing so, you make sure that no checks bounce. Eventually, manna from heaven arrives (perhaps in the form of money from home), and you are able to cover your outstanding checks.

To make it interesting, suppose you are absolutely certain that no checks will bounce along the way. Assuming this is true, and ignoring any question of legality (what we have described is probably illegal check kiting), is there anything unethical about this? If you say yes, then why? In particular, who is harmed?

QUESTIONS AND PROBLEMS



BASIC

(Questions 1–10)

1. **Calculating Float [LO1]** In a typical month, the Monk Corporation receives 80 checks totaling \$113,000. These are delayed four days on average. What is the average daily float? Assume 30 days in a month.
2. **Calculating Net Float [LO1]** Each business day, on average, a company writes checks totaling \$17,000 to pay its suppliers. The usual clearing time for the checks is four days. Meanwhile, the company is receiving payments from its customers each day, in the form of checks, totaling \$22,000. The cash from the payments is available to the firm after two days.
 - a. Calculate the company's disbursement float, collection float, and net float.
 - b. How would your answer to part (a) change if the collected funds were available in one day instead of two?
3. **Costs of Float [LO1]** Purple Feet Wine, Inc., receives an average of \$17,500 in checks per day. The delay in clearing is typically three days. The current interest rate is .017 percent per day.
 - a. What is the company's float?
 - b. What is the most the company should be willing to pay today to eliminate its float entirely?
 - c. What is the highest daily fee the company should be willing to pay to eliminate its float entirely?
4. **Float and Weighted Average Delay [LO1]** Your neighbor goes to the post office once a month and picks up two checks, one for \$10,700 and one for \$4,600. The larger check takes four days to clear after it is deposited; the smaller one takes three days. Assume 30 days in a month.
 - a. What is the total float for the month?
 - b. What is the average daily float?
 - c. What are the average daily receipts and weighted average delay?
5. **NPV and Collection Time [LO2]** Your firm has an average receipt size of \$125. A bank has approached you concerning a lockbox service that will decrease your total collection time by two days. You typically receive 5,100 checks per day. The daily interest rate is .016 percent. If the bank charges a fee of \$175 per day, should the lockbox project be accepted? What would the net annual savings be if the service were adopted?
6. **Using Weighted Average Delay [LO1]** A mail-order firm processes 5,300 checks per month. Of these, 60 percent are for \$47 and 40 percent are for \$79. The \$47 checks are delayed two days on average; the \$79 checks are delayed three days on average. Assume 30 days in a month.
 - a. What is the average daily collection float? How do you interpret your answer?
 - b. What is the weighted average delay? Use the result to calculate the average daily float.
 - c. How much should the firm be willing to pay to eliminate the float?

- d. If the interest rate is 7 percent per year, calculate the daily cost of the float.
 - e. How much should the firm be willing to pay to reduce the weighted average float to 1.5 days?
7. **Value of Lockboxes [LO2]** Paper Submarine Manufacturing is investigating a lockbox system to reduce its collection time. It has determined the following:

Average number of payments per day	485
Average value of payment	\$935
Variable lockbox fee (per transaction)	\$.15
Daily interest rate on money market securities	.068%

The total collection time will be reduced by three days if the lockbox system is adopted.

- a. What is the PV of adopting the system?
 - b. What is the NPV of adopting the system?
 - c. What is the net cash flow per day from adopting the system? Per check?
8. **Lockboxes and Collections [LO2]** It takes Cookie Cutter Modular Homes, Inc., about six days to receive and deposit checks from customers. The company's management is considering a lockbox system to reduce the firm's collection times. It is expected that the lockbox system will reduce receipt and deposit times to three days total. Average daily collections are \$175,000, and the required rate of return is 4 percent per year. Assume 365 days per year.
- a. What is the reduction in outstanding cash balances as a result of implementing the lockbox system?
 - b. What is the dollar return that could be earned on these savings?
 - c. What is the maximum monthly charge the company should pay for this lockbox system if the payment is due at the end of the month? What if the payment is due at the beginning of the month?
9. **Value of Delay [LO2]** Every two weeks, No More Pencils, Inc., disburses checks that average \$107,000 and take seven days to clear. How much interest can the company earn annually if it delays transfer of funds from an interest-bearing account that pays .009 percent per day for these seven days? Ignore the effects of compounding interest.
10. **NPV and Reducing Float [LO2]** No More Books Corporation has an agreement with Floyd Bank whereby the bank handles \$4.5 million in collections per day and requires a \$340,000 compensating balance. No More Books is contemplating canceling the agreement and dividing its eastern region so that two other banks will handle its business. Banks A and B will each handle \$2.25 million of collections per day, and each requires a compensating balance of \$195,000. No More Books's financial management expects that collections will be accelerated by one day if the eastern region is divided. Should the company proceed with the new system? What will be the annual net savings? Assume that the T-bill rate is 2.5 percent annually.
11. **Lockboxes and Collection Time [LO2]** Bird's Eye Treehouses, Inc., a Kentucky company, has determined that a majority of its customers are located in the Pennsylvania area. It therefore is considering using a lockbox system offered by a bank located in Pittsburgh. The bank has estimated that use of the system will reduce collection time by 1.5 days. Based on the following information, should the lockbox system be adopted?

INTERMEDIATE

(Questions 11–12)

Average number of payments per day	950
Average value of payment	\$725
Variable lockbox fee (per transaction)	\$15
Annual interest rate on money market securities	5.5%

How would your answer change if there were a fixed charge of \$5,000 per year in addition to the variable charge? Assume 365 days per year.

- 12. Calculating Transactions Required [LO2]** Cow Chips, Inc., a large fertilizer distributor based in California, is planning to use a lockbox system to speed up collections from its customers located on the East Coast. A Philadelphia-area bank will provide this service for an annual fee of \$6,500 plus 10 cents per transaction. The estimated reduction in collection and processing time is one day. If the average customer payment in this region is \$2,900, how many customers each day, on average, are needed to make the system profitable for Cow Chips? Treasury bills are currently yielding 4 percent per year, and there are 365 days per year.

MINICASE

Cash Management at Webb Corporation

Webb Corporation was founded 20 years ago by its president, Bryan Webb. The company originally began as a mail-order company, but it has grown rapidly in recent years, in large part due to its website. Because of the wide geographical dispersion of the company's customers, it currently employs a lockbox system with collection centers in San Francisco, St. Louis, Atlanta, and Boston.

Holly Lennon, the company's treasurer, has been examining the current cash collection policies. On average, each lockbox center handles \$207,000 in payments each day. The company's current policy is to invest these payments in short-term marketable securities daily at the collection center banks. Every two weeks, the investment accounts are swept; the proceeds are wire-transferred to Webb's headquarters in Dallas to meet the company's payroll. The investment accounts each earn .013 percent per day, and the wire transfers cost .20 percent of the amount transferred.

Holly has been approached by Third National Bank, located just outside Dallas, about the possibility of setting up a

concentration banking system for Webb Corp. Third National will accept each of the lockbox center's daily payments via automated clearinghouse (ACH) transfers in lieu of wire transfers. The ACH-transferred funds will not be available for use for one day. Once cleared, the funds will be deposited in a short-term account, which will yield .013 percent per day. Each ACH transfer will cost \$175. Bryan has asked Holly to determine which cash management system will be the best for the company. As her assistant, Holly has asked you to answer the following questions.

QUESTIONS

- What is Webb Corporation's total net cash flow available from the current lockbox system to meet payroll?
- Under the terms outlined by Third National Bank, should the company proceed with the concentration banking system?
- What cost of ACH transfers would make the company indifferent between the two systems?

19A Determining the Target Cash Balance

target cash balance

A firm's desired cash level as determined by the trade-off between carrying costs and shortage costs.

Based on our general discussion of current assets in the previous chapter, the **target cash balance** involves a trade-off between the opportunity costs of holding too much cash (the carrying costs) and the costs of holding too little cash (the shortage costs, also called **adjustment costs**). The nature of these costs depends on the firm's working capital policy.

If the firm has a flexible working capital policy, it will probably maintain a marketable securities portfolio. In this case, the adjustment, or shortage, costs will be the trading costs associated with buying and selling securities. If the firm has a restrictive working capital

policy, it will probably borrow in the short term to meet cash shortages. The costs in this case will be the interest and other expenses associated with arranging a loan.

In our discussion that follows, we will assume the firm has a flexible policy. Its cash management, then, consists of moving money in and out of marketable securities. This is a traditional approach to the subject, and it is a nice way of illustrating the costs and benefits of holding cash.

Keep in mind that the distinction between cash and money market investments is becoming increasingly blurred. For example, how do we classify a money market fund with check-writing privileges? Such near-cash arrangements are becoming more common. It may be that the prime reason they are not universal is regulation limiting their usage. We will return to this subject of such arrangements at various points in the following discussion.

THE BASIC IDEA

Figure 19A.1 presents the cash management problem for our flexible firm. If a firm tries to keep its cash holdings too low, it will find itself running out of cash more often than is desirable and selling marketable securities (and perhaps later buying marketable securities to replace those sold) more frequently than would be the case if the cash balance were higher. Trading costs will be high when the cash balance is small. These costs will fall as the cash balance becomes larger.

In contrast, the opportunity costs of holding cash are low if the firm holds little cash. These costs increase as the cash holdings rise because the firm is giving up more interest that could have been earned.

In Figure 19A.1, the sum of the costs is given by the total cost curve. As shown, the minimum total cost occurs where the two individual cost curves cross at Point C^* . At this

adjustment costs

The costs associated with holding too little cash. Also, *shortage costs*.

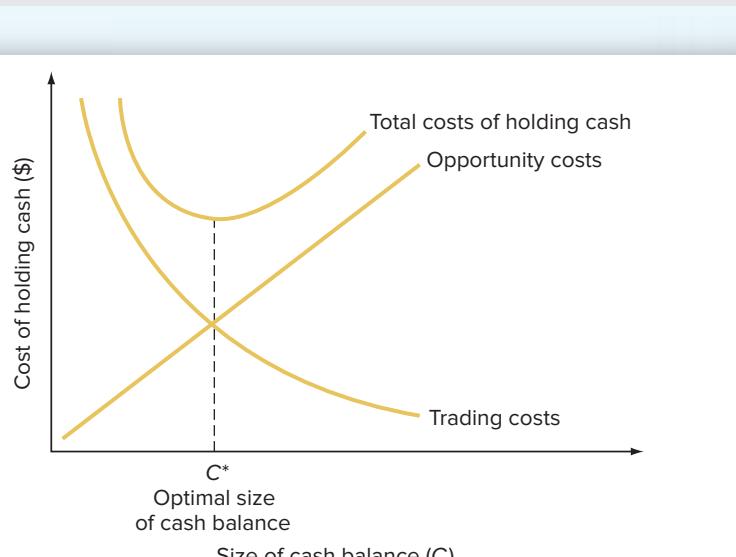


FIGURE 19A.1
Cost of Holding Cash

Trading costs are increased when the firm must sell securities to establish a cash balance. Opportunity costs are increased when there is a cash balance because there is no return on cash.

point, the opportunity costs and the trading costs are equal. This point represents the target cash balance, and it is the point the firm should try to find.

Figure 19A.1 is essentially the same as Figure 18.2 in the previous chapter. As we discuss next, we can now say more about the optimal investment in cash and the factors that influence it.

THE BAT MODEL

The Baumol-Allais-Tobin (BAT) model is a classic means of analyzing our cash management problem. We will show how this model can be used to actually establish the target cash balance. It is a straightforward model useful for illustrating the factors in cash management and, more generally, current asset management.

To develop the BAT model, suppose the Golden Socks Corporation starts off at Week 0 with a cash balance of $C = \$1.2$ million. Each week, outflows exceed inflows by \$600,000. As a result, the cash balance will drop to zero at the end of Week 2. The average cash balance will be the beginning balance (\$1.2 million) plus the ending balance (\$0) divided by 2, or $(\$1.2 \text{ million} + 0)/2 = \$600,000$, over the two-week period. At the end of Week 2, Golden Socks replenishes its cash by depositing another \$1.2 million.

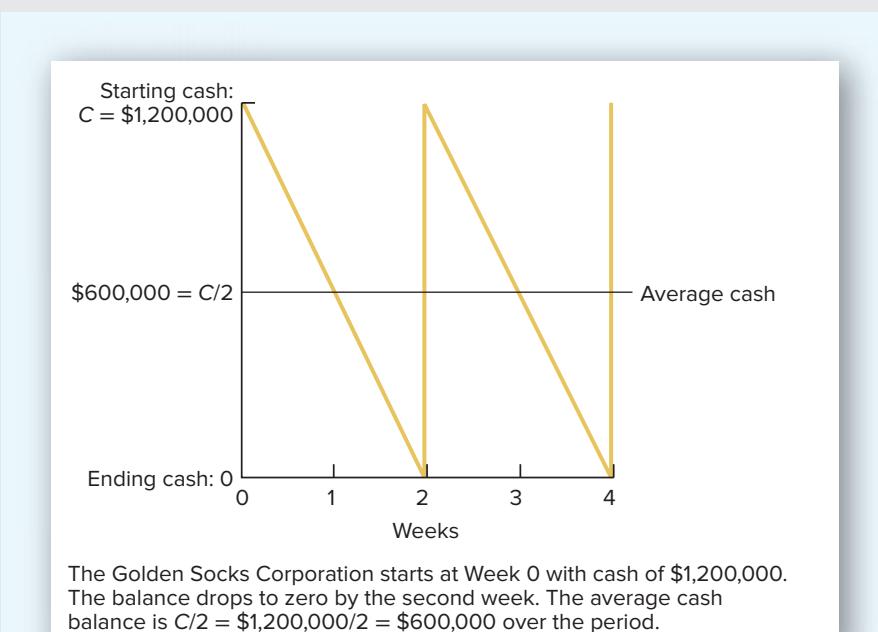
As we have described, the simple cash management strategy for Golden Socks boils down to depositing \$1.2 million every two weeks. This policy is shown in Figure 19A.2. Notice how the cash balance declines by \$600,000 per week. Because the company brings the account back up to \$1.2 million, the balance hits zero every two weeks. This results in the sawtooth pattern displayed in Figure 19A.2.

Implicitly, we assume that the net cash outflow is the same every day and is known with certainty. These two assumptions make the model easy to handle. We will indicate in the next section what happens when these assumptions do not hold.

If C were set higher, say, at \$2.4 million, cash would last four weeks before the firm would have to sell marketable securities; but the firm's average cash balance would increase

FIGURE 19A.2

Cash Balances for the Golden Socks Corporation



to \$1.2 million (from \$600,000). If C were set at \$600,000, cash would run out in one week, and the firm would have to replenish cash more frequently; but the average cash balance would fall from \$600,000 to \$300,000.

Because transaction costs (for example, the brokerage costs of selling marketable securities) must be incurred whenever cash is replenished, establishing large initial balances will lower the trading costs connected with cash management. However, the larger the average cash balance, the greater is the opportunity cost (the return that could have been earned on marketable securities).

To determine the optimal strategy, Golden Socks needs to know the following three things:

F = The fixed cost of making a securities trade to replenish cash.

T = The total amount of new cash needed for transaction purposes over the relevant planning period—say, one year.

R = The opportunity cost of holding cash. This is the interest rate on marketable securities.

With this information, Golden Socks can determine the total costs of any particular cash balance policy. It can then determine the optimal cash balance policy.

The Opportunity Costs To determine the opportunity costs of holding cash, we have to find out how much interest is forgone. Golden Socks has, on average, $C/2$ in cash. This amount could be earning interest at rate R . So the total dollar opportunity costs of cash balances are equal to the average cash balance multiplied by the interest rate:

$$\text{Opportunity costs} = (C/2) \times R$$

19A.1

The opportunity costs of various alternatives are given here, assuming that the interest rate is 10 percent:

Initial Cash Balance	Average Cash Balance	Opportunity Cost ($R = .10$)
C	$C/2$	$(C/2) \times R$
\$4,800,000	\$2,400,000	\$240,000
2,400,000	1,200,000	120,000
1,200,000	600,000	60,000
600,000	300,000	30,000
300,000	150,000	15,000

In our original case, in which the initial cash balance is **\$1.2 million**, the average balance is **\$600,000**. The interest Golden Socks could have earned on this (at 10 percent) is **\$60,000**, so this is what the firm gives up with this strategy. Notice that the opportunity costs increase as the initial (and average) cash balance rises.

The Trading Costs To determine the total trading costs for the year, we need to know how many times Golden Socks will have to sell marketable securities during the year. First, the total amount of cash disbursed during the year is \$600,000 per week, so $T = \$600,000 \times 52 \text{ weeks} = \31.2 million . If the initial cash balance is set at $C = \$1.2 \text{ million}$, Golden Socks will sell \$1.2 million in marketable securities: $T/C = \$31.2 \text{ million}/\$1.2 \text{ million} = 26$ times per year. It costs F dollars each time, so trading costs are given by:

$$\frac{\$31.2 \text{ million}}{\$1.2 \text{ million}} \times F = 26 \times F$$

In general, the total trading costs will be given by:

$$\text{Trading costs} = (T/C) \times F$$

19A.2

In this example, if F were \$1,000 (an unrealistically large amount), the trading costs would be **\$26,000**.

We can calculate the trading costs associated with some different strategies as follows:

Total Amount of Disbursements During Relevant Period	Initial Cash Balance	Trading Costs ($F = \$1,000$)
T	C	$(T/C) \times F$
\$31,200,000	\$4,800,000	\$ 6,500
31,200,000	2,400,000	13,000
31,200,000	1,200,000	26,000
31,200,000	600,000	52,000
31,200,000	300,000	104,000

The Total Cost Now that we have the opportunity costs and the trading costs, we can calculate the total cost by adding them together:

$$\begin{aligned}\text{Total cost} &= \text{Opportunity costs} + \text{Trading costs} \\ &= (C/2) \times R + (T/C) \times F\end{aligned}$$

19A.3

Using the numbers generated earlier, we have the following:

Cash Balance	Opportunity Costs	+	Trading Costs	=	Total Cost
\$4,800,000	\$240,000		\$ 6,500		\$246,500
2,400,000	120,000		13,000		133,000
1,200,000	60,000		26,000		86,000
600,000	30,000		52,000		82,000
300,000	15,000		104,000		119,000

Notice how the total cost starts out at almost \$250,000 (**\$246,500**) and declines to **\$82,000** before starting to rise again.

The Solution We can see from the preceding schedule that a **\$600,000** cash balance results in the lowest total cost of the possibilities presented: **\$82,000**. But what about \$700,000 or \$500,000 or other possibilities? It appears that the optimal balance is somewhere between \$300,000 and \$1.2 million. With this in mind, we could easily proceed by trial and error to find the optimal balance. It is not difficult to find it directly so we do this next.

Take a look back at Figure 19A.1. As the figure is drawn, the optimal size of the cash balance, C^* , occurs right where the two lines cross. At this point, the opportunity costs and the trading costs are exactly equal. So at C^* , it must be that:

$$\text{Opportunity costs} = \text{Trading costs}$$

$$(C^*/2) \times R = (T/C^*) \times F$$

With a little algebra, we can write:

$$C^{*2} = (2T \times F)/R$$

To solve for C^* , we take the square root of both sides to get:

$$C^* = \sqrt{(2T \times F)/R}$$

19A.4

This is the optimal initial cash balance.

For Golden Socks, we have $T = \$31.2$ million, $F = \$1,000$, and $R = 10\%$. We can now find the optimal cash balance:

$$\begin{aligned} C^* &= \sqrt{(2 \times \$31,200,000 \times 1,000)/.10} \\ &= \sqrt{\$624 \text{ billion}} \\ &= \$789,937 \end{aligned}$$

We can verify this answer by calculating the various costs at this balance, as well as a little above and a little below this balance:

Cash Balance	Opportunity Costs	+	Trading Costs	=	Total Cost
\$850,000	\$42,500		\$36,706		\$79,206
800,000	40,000		39,000		79,000
789,937	39,497		39,497		78,994
750,000	37,500		41,600		79,100
700,000	35,000		44,571		79,571

The total cost at the optimal cash level is **$\$78,994$** and increases as the cash balance moves in either direction.

The BAT Model

EXAMPLE 19A.1

The Vulcan Corporation has cash outflows of \$100 per day, seven days a week. The interest rate is 5 percent, and the fixed cost of replenishing cash balances is \$10 per transaction. What is the optimal initial cash balance? What is the total cost?

The total cash needed for the year is $365 \text{ days} \times \$100 = \$36,500$. From the BAT model, we have that the optimal initial balance is:

$$\begin{aligned} C^* &= \sqrt{(2T \times F)/R} \\ &= \sqrt{(2 \times \$36,500 \times 10)/.05} \\ &= \sqrt{\$14.6 \text{ million}} \\ &= \$3,821 \end{aligned}$$

The average cash balance is $\$3,821/2 = \$1,910$, so the opportunity cost is $\$1,910 \times .05 = \96 . Because Vulcan needs \$100 per day, the \$3,821 balance will last $\$3,821/\$100 = 38.21$ days. The firm needs to resupply the account $365/38.21 = 9.6$ times per year, so the trading (order) cost is \$96. The total cost is \$191.

Conclusion The BAT model is possibly the simplest model for determining the optimal cash position. Its chief weakness is that it assumes steady, certain cash outflows. Next, we discuss a more involved model designed to deal with this limitation.

THE MILLER-ORR MODEL: A MORE GENERAL APPROACH

We now describe a cash management system designed to deal with cash inflows and outflows that fluctuate randomly from day to day. With this model, we again concentrate on the cash balance. But in contrast to the situation with the BAT model, we assume that this balance fluctuates up and down randomly and that the average change is zero.

The Basic Idea Figure 19A.3 shows how the system works. It operates in terms of an upper limit (U^*) and a lower limit (L) to the amount of cash, as well as a target cash balance (C^*). The firm allows its cash balance to fluctuate between the lower and upper limits. As long as the cash balance is somewhere between U^* and L , nothing happens.

When the cash balance reaches the upper limit (U^*), as it does at Point X, the firm moves $U^* - C^*$ dollars out of the account and into marketable securities. This action moves the cash balance down to C^* . In the same way, if the cash balance falls to the lower limit (L), as it does at Point Y, the firm will sell $C^* - L$ worth of securities and deposit the cash in the account. This action takes the cash balance up to C^* .

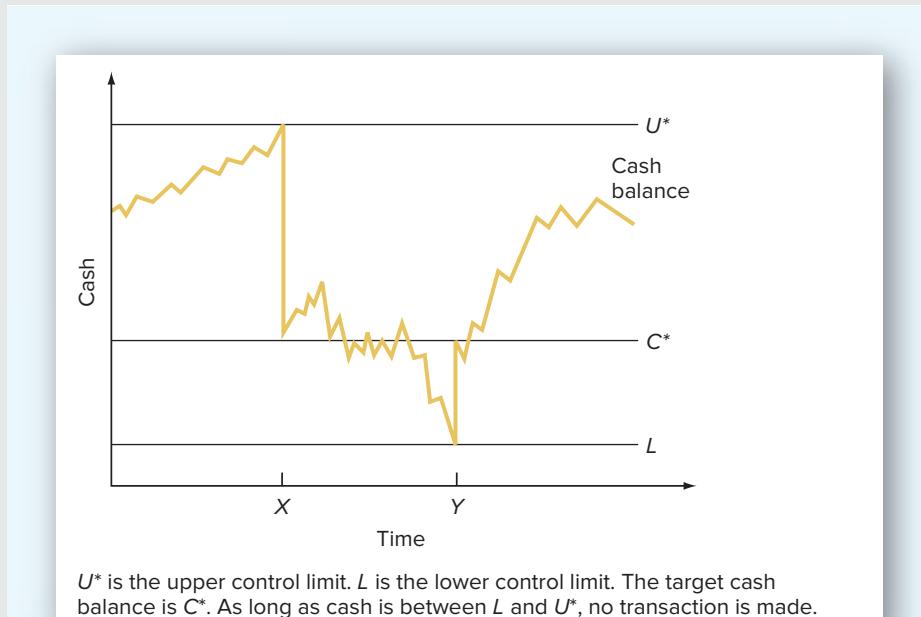
Using the Model To get started, management sets the lower limit (L). This limit essentially defines a safety stock; so where it is set depends on how much risk of a cash shortfall the firm is willing to tolerate. Alternatively, the minimum might equal a required compensating balance.

As with the BAT model, the optimal cash balance depends on trading costs and opportunity costs. Once again, the cost per transaction of buying and selling marketable securities, F , is assumed to be fixed. Also, the opportunity cost of holding cash is R , the interest rate per period on marketable securities.

The only extra piece of information needed is σ^2 , the variance of the net cash flow per period. For our purposes, the period can be anything—a day or a week, for example—as long as the interest rate and the variance are based on the same length of time.

FIGURE 19A.3

The Miller-Orr Model



Given L , which is set by the firm, Miller and Orr show that the cash balance target, C^* , and the upper limit, U^* , that minimize the total costs of holding cash are:²

$$C^* = L + (3/4 \times F \times \sigma^2/R)^{1/3}$$

$$U^* = 3 \times C^* - 2 \times L$$

19A.5

19A.6

19A.7

Also, the average cash balance in the Miller-Orr model is:

$$\text{Average cash balance} = (4 \times C^* - L)/3$$

The derivation of these expressions is relatively complex, so we will not present it here. Fortunately, as we illustrate next, the results are not difficult to use.

For example, suppose $F = \$10$, the interest rate is 1 percent per month, and the standard deviation of the monthly net cash flows is \$200. The variance of the monthly net cash flows is:

$$\sigma^2 = \$200^2 = \$40,000$$

We assume a minimum cash balance of $L = \$100$. We can calculate the cash balance target, C^* , as follows:

$$\begin{aligned} C^* &= L + (3/4 \times F \times \sigma^2/R)^{1/3} \\ &= \$100 + (3/4 \times \$10 \times \$40,000/.01)^{1/3} \\ &= \$100 + 30,000,000^{1/3} \\ &= \$100 + 311 = \$411 \end{aligned}$$

The upper limit, U^* , is:

$$\begin{aligned} U^* &= 3 \times C^* - 2 \times L \\ &= 3 \times \$411 - 2 \times \$100 \\ &= \$1,032 \end{aligned}$$

Finally, the average cash balance will be:

$$\begin{aligned} \text{Average cash balance} &= (4 \times C^* - L)/3 \\ &= (4 \times \$411 - \$100)/3 \\ &= \$514 \end{aligned}$$

IMPLICATIONS OF THE BAT AND MILLER-ORR MODELS

Our two cash management models differ in complexity, but they have some similar implications. In both cases, all other things being equal, we see that:

1. The greater the interest rate, the lower is the target cash balance.
2. The greater the order cost, the higher is the target cash balance.

These implications are both fairly obvious. The advantage of the Miller-Orr model is that it improves our understanding of the problem of cash management by considering the effect of uncertainty as measured by the variation in net cash inflows.

The Miller-Orr model shows that the greater the uncertainty (the higher σ^2 is), the greater the difference between the target balance and the minimum balance will be. Similarly, the greater the uncertainty, the higher the upper limit and the average cash balance will be. These statements all make intuitive sense. For example, the greater the variability, the greater will be the chance that the balance will drop below the minimum. We keep a higher balance to guard against this possibility.

²M. H. Miller and D. Orr, "A Model of the Demand for Money by Firms," *Quarterly Journal of Economics*, August 1966.

OTHER FACTORS INFLUENCING THE TARGET CASH BALANCE

Before moving on, we briefly discuss two additional considerations that affect the target cash balance.

First, in our discussion of cash management, we assume cash is invested in marketable securities such as Treasury bills. The firm obtains cash by selling these securities. Another alternative is to borrow cash. Borrowing introduces additional considerations to cash management:

1. Borrowing is likely to be more expensive than selling marketable securities because the interest rate is likely to be higher.
2. The need to borrow will depend on management's desire to hold low cash balances. A firm is more likely to have to borrow to cover an unexpected cash outflow with greater cash flow variability and lower investment in marketable securities.

Second, for large firms, the trading costs of buying and selling securities are small when compared to the opportunity costs of holding cash. Suppose a firm has \$1 million in cash that won't be needed for 24 hours. Should the firm invest the money or leave it sitting?

Suppose the firm can invest the money at an annualized rate of 7.57 percent per year. The daily rate in this case is about two basis points (.02 percent, or .0002).³ The daily return earned on \$1 million is $.0002 \times \$1\text{ million} = \200 . In many cases, the order cost will be much less than this; so a large firm will buy and sell securities very often before it will opt to leave substantial amounts of cash idle.

Concept Questions

- 19A.1a** What is a target cash balance?
- 19A.1b** What is the basic trade-off in the BAT model?
- 19A.1c** Describe how the Miller-Orr model works.

APPENDIX REVIEW AND SELF-TEST PROBLEM

- 19A.1 The BAT Model** Given the following information, calculate the target cash balance using the BAT model:

Annual interest rate	12%
Fixed order cost	\$100
Total cash needed	\$240,000

What are the opportunity cost of holding cash, the trading cost, and the total cost? What would each of these costs be if \$15,000 were held instead? If \$25,000 were held?

³A basis point is 1 percent of 1 percent. Also, the annual interest rate is calculated as $(1 + R)^{365} = 1.0757$, implying a daily rate of .02 percent.

ANSWER TO APPENDIX REVIEW AND SELF-TEST PROBLEM

- 19A.1** From the BAT model, we know that the target cash balance is:

$$\begin{aligned} C^* &= \sqrt{(2T \times F)/R} \\ &= \sqrt{(2 \times \$240,000 \times \$100)/.12} \\ &= \sqrt{\$400,000,000} \\ &= \$20,000 \end{aligned}$$

The average cash balance will be $C^*/2 = \$20,000/2 = \$10,000$. The opportunity cost of holding \$10,000 when the going rate is 12 percent is $\$10,000 \times .12 = \$1,200$. There will be $\$240,000/\$20,000 = 12$ orders during the year, so the order cost, or trading cost, is also $12 \times \$100 = \$1,200$. The total cost is thus $\$2,400$.

If \$15,000 is held, the average balance is $\$7,500$. Verify that the opportunity, trading, and total costs in this case are $\$900$, $\$1,600$, and $\$2,500$, respectively. If \$25,000 is held, these numbers are $\$1,500$, $\$960$, and $\$2,460$, respectively.

QUESTIONS AND PROBLEMS

- Changes in Target Cash Balances [LO2]** Indicate the likely impact of each of the following on a company's target cash balance. Use the letter *I* to denote an increase and *D* to denote a decrease. Briefly explain your reasoning in each case:
 - Commissions charged by brokers decrease.
 - Interest rates paid on money market securities rise.
 - The compensating balance requirement of a bank is raised.
 - The firm's credit rating improves.
 - The cost of borrowing increases.
 - Direct fees for banking services are established.
- Using the BAT Model [LO2]** Given the following information, calculate the target cash balance using the BAT model:

Annual interest rate	4.5%
Fixed order cost	\$25
Total cash needed	\$10,200

How do you interpret your answer?

- Opportunity versus Trading Costs [LO2]** White Whale Corporation has an average daily cash balance of \$1,700. Total cash needed for the year is \$64,000. The interest rate is 5 percent, and replenishing the cash costs \$8 each time. What are the opportunity cost of holding cash, the trading cost, and the total cost? What do you think of White Whale's strategy?
- Costs and the BAT Model [LO2]** Debit and Credit Bookkeepers needs a total of \$21,000 in cash during the year for transactions and other purposes. Whenever cash runs low, it sells \$1,500 in securities and transfers in the cash. The interest rate is 4 percent per year, and selling securities costs \$25 per sale.
 - What is the opportunity cost under the current policy? The trading cost? With no additional calculations, would you say that Debit and Credit keeps too much or too little cash? Explain.
 - What is the target cash balance derived using the BAT model?



BASIC

(Questions 1–10)

5. **Determining Optimal Cash Balances [LO2]** The All Day Company is currently holding \$690,000 in cash. It projects that over the next year its cash outflows will exceed cash inflows by \$140,000 per month. How much of the current cash holdings should be retained, and how much should be used to increase the company's holdings of marketable securities? Each time these securities are bought or sold through a broker, the company pays a fee of \$250. The annual interest rate on money market securities is 3.2 percent. After the initial investment of excess cash, how many times during the next 12 months will securities be sold?
6. **Interpreting Miller-Orr [LO2]** All Night, Inc., uses a Miller-Orr cash management approach with a lower limit of \$43,000, an upper limit of \$125,000, and a target balance of \$80,000. Explain what each of these points represents; then explain how the system will work.
7. **Using Miller-Orr [LO2]** Slap Shot Corporation has a fixed cost of \$40 associated with buying and selling marketable securities. The interest rate is currently .013 percent per day, and the firm has estimated that the standard deviation of its daily net cash flows is \$80. Management has set a lower limit of \$1,500 on cash holdings. Calculate the target cash balance and upper limit using the Miller-Orr model. Describe how the system will work.
8. **Interpreting Miller-Orr [LO2]** Based on the Miller-Orr model, describe what will happen to the lower limit, the upper limit, and the spread (the distance between the two) if the variation in net cash flow grows. Give an intuitive explanation for why this happens. What happens if the variance drops to zero?
9. **Using Miller-Orr [LO2]** The variance of the daily cash flows for the Pele Bicycle Shop is \$890,000. The opportunity cost to the firm of holding cash is 4.1 percent per year. What should the target cash level and the upper limit be if the tolerable lower limit has been established as \$160,000? The fixed cost of buying and selling securities is \$300 per transaction.
10. **Using BAT [LO2]** Rise Against Corporation has determined that its target cash balance if it uses the BAT model is \$5,100. The total cash needed for the year is \$31,000, and the order cost is \$10. What interest rate must Rise Against be using?

Credit and Inventory Management

20

Chapter

IN SEPTEMBER 2016, HANJIN SHIPPING declared bankruptcy. While most people were unaware of the company before the bankruptcy filing, Hanjin controlled just over 3 percent of worldwide shipping traffic. Because banks pulled funding for dock fees, container unloading, and storage, 97 of the company's ships, carrying 500,000 containers worth \$14 billion in cargo, were stranded at sea. This delay affected many companies. For example, Samsung had \$38 million in inventory on the ocean in Hanjin's ships. Competitor Apple delayed the debut of its new iPhone 7 and iPhone 7 Plus at least three weeks because much of the new iPhone inventory was also sailing the ocean in circles. Meanwhile, Ford, with its cargo sitting portside in Australia for two weeks, was forced to fly in sheet metal, glass, and steering components—a much more expensive process.

As these examples show, inventory disruptions can cause major problems for businesses, but companies also dislike carrying excessive inventory levels for a variety of reasons. In this chapter, we discuss, among other things, how companies arrive at an optimal inventory level.

Learning Objectives

After studying this chapter, you should be able to:

- L01** Explain how firms manage their receivables and the basic components of a firm's credit policies.
- L02** Analyze a firm's decision to grant credit.
- L03** Define the types of inventory and inventory management systems used by firms.
- L04** Determine the costs of carrying inventory and the optimal inventory level.

©by_adri/StockPhoto/Gettyimages

For updates on the latest happenings in finance, visit fundamentals-of-corporate-finance.blogspot.com.

20.1 Credit and Receivables

When a firm sells goods and services, it can demand cash on or before the delivery date or it can extend credit to customers and allow some delay in payment. The next few sections provide an idea of what is involved in the firm's decision to grant credit to its customers. Granting credit is making an investment in a customer—an investment tied to the sale of a product or service.

Why do firms grant credit? Not all do, but the practice is extremely common. The obvious reason is that offering credit is a way of stimulating sales. The costs associated with granting credit are not trivial. First, there is the chance that the customer will not pay. Second, the firm has to bear the costs of carrying the receivables. The credit policy decision thus involves a trade-off between the benefits of increased sales and the costs of granting credit.

From an accounting perspective, when credit is granted, an account receivable is created. Such receivables include credit to other firms, called *trade credit*, and credit granted to consumers, called *consumer credit*. About one-sixth of all the assets of U.S. industrial firms are in the form of accounts receivable, so receivables obviously represent a major investment of financial resources by U.S. businesses.

COMPONENTS OF CREDIT POLICY

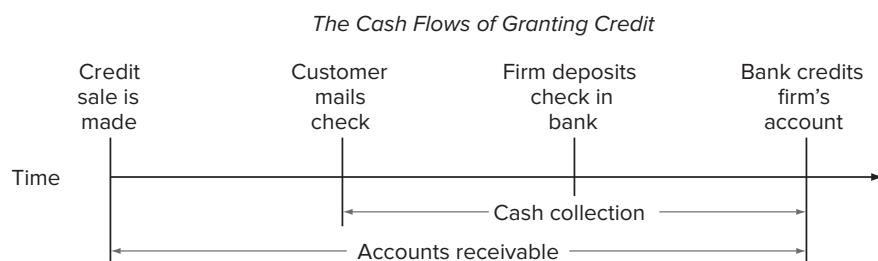
If a firm decides to grant credit to its customers, then it must establish procedures for extending credit and collecting payment. In particular, the firm will have to deal with the following components of credit policy:

- Terms of sale:** The terms of sale establish how the firm proposes to sell its goods and services. A basic decision is whether the firm will require cash or will extend credit. If the firm does grant credit to a customer, the terms of sale will specify (perhaps implicitly) the credit period, the cash discount and discount period, and the type of credit instrument.
- Credit analysis:** In granting credit, a firm determines how much effort to expend trying to distinguish between customers who will pay and customers who will not pay. Firms use a number of devices and procedures to determine the probability that customers will not pay; put together, these are called credit analysis.
- Collection policy:** After credit has been granted, the firm has the potential problem of collecting the cash, for which it must establish a collection policy.

In the next several sections, we will discuss these components of credit policy that collectively make up the decision to grant credit.

THE CASH FLOWS FROM GRANTING CREDIT

In a previous chapter, we described the accounts receivable period as the time it takes to collect on a sale. There are several events that occur during this period. These events are the cash flows associated with granting credit, and they can be illustrated with a cash flow diagram:



These companies assist businesses with working capital management:
www.treasury.pncbank.com and www.treasurystrategies.com.

As our time line indicates, the typical sequence of events when a firm grants credit is as follows: (1) The credit sale is made, (2) the customer sends a check to the firm, (3) the firm deposits the check, and (4) the firm's account is credited for the amount of the check.

Based on our discussion in the previous chapter, it is apparent that one of the factors influencing the receivables period is float. One way to reduce the receivables period is to speed up check mailing, processing, and clearing. Because we cover this subject elsewhere, we will ignore float in the subsequent discussion and focus on what is likely to be the major determinant of the receivables period: Credit policy.

THE INVESTMENT IN RECEIVABLES

The investment in accounts receivable for any firm depends on the amount of credit sales and the average collection period. For example, if a firm's average collection period, ACP, is 30 days, then, at any given time, there will be 30 days' worth of sales outstanding. If credit sales run \$1,000 per day, the firm's accounts receivable will then be equal to $30 \text{ days} \times \$1,000 \text{ per day} = \$30,000$, on average.

As our example illustrates, a firm's receivables generally will be equal to its average daily sales multiplied by its average collection period:

$$\text{Accounts receivable} = \text{Average daily sales} \times \text{ACP}$$

As this equation shows, a firm's investment in accounts receivable depends on factors that influence credit sales and collections.

We have seen the average collection period in various places, including Chapter 3 and Chapter 18. Recall that we use the terms *days' sales in receivables*, *receivables period*, and *average collection period* interchangeably to refer to the length of time it takes for the firm to collect on a sale.



For more on accounts receivable management, visit www.insidearm.com.

20.1

Concept Questions

- 20.1a** What are the basic components of credit policy?
- 20.1b** What are the basic components of the terms of sale if a firm chooses to sell on credit?

Terms of the Sale

20.2

As we described previously, the terms of a sale are made up of three distinct elements:

1. The period for which credit is granted (the credit period).
2. The cash discount and the discount period.
3. The type of credit instrument.

Within a given industry, the terms of sale are usually fairly standard, but these terms vary quite a bit across industries. In many cases, the terms of sale are remarkably archaic and literally date to previous centuries. Organized systems of trade credit that resemble current practice can be easily traced to the great fairs of medieval Europe, and they almost surely existed long before then.

THE BASIC FORM

The easiest way to understand the terms of sale is to consider an example. Terms such as 2/10, net 60 are common. This means that customers have 60 days from the invoice date (discussed a bit later) to pay the full amount; however, if payment is made within 10 days, a 2 percent cash discount can be taken.

Consider a buyer who places an order for \$1,000, and assume that the terms of the sale are 2/10, net 60. The buyer has the option of paying $\$1,000 \times (1 - .02) = \980 in 10 days, or paying the full \$1,000 in 60 days. If the terms are stated as just net 30, then the customer has 30 days from the invoice date to pay the entire \$1,000, and no discount is offered for early payment.

In general, credit terms are interpreted in the following way:

<Take this discount off the invoice price> / <If you pay in this many days>,
 <Or pay the full invoice amount in this many days>

Terms of 5/10, net 45 mean: Take a 5 percent discount from the full price if you pay within 10 days, or pay the full amount in 45 days.

THE CREDIT PERIOD

credit period

The length of time for which credit is granted.

The **credit period** is the length of time for which credit is granted. The credit period varies widely from industry to industry, but it is almost always between 30 and 120 days. If a cash discount is offered, then the credit period has two components: The net credit period and the cash discount period.

The net credit period is the length of time the customer has to pay. The cash discount period is the time during which the discount is available. With 2/10, net 30, the net credit period is 30 days and the cash discount period is 10 days.

invoice

A bill for goods or services provided by the seller to the purchaser.

The Invoice Date The invoice date is the beginning of the credit period. An **invoice** is a written account of merchandise shipped to the buyer. For individual items, by convention, the invoice date is usually the shipping date or the billing date, *not* the date on which the buyer receives the goods or the bill.

Many other arrangements exist. The terms of sale might be ROG, for *receipt of goods*. In this case, the credit period starts when the customer receives the order. This might be used when the customer is in a remote location.

With EOM dating, all sales made during a particular month are assumed to be made at the end of that month. This is useful when a buyer makes purchases throughout the month, but the seller bills only once a month.

Terms of 2/10th, EOM tell the buyer to take a 2 percent discount if payment is made by the 10th of the month; otherwise the full amount is due by the end of the month. Confusingly, the end of the month is sometimes taken to be the 25th day of the month. MOM, for middle of month, is another variation.

Seasonal dating is sometimes used to encourage sales of seasonal products during the off-season. A product sold primarily in the summer (e.g., suntan oil) can be shipped in January with credit terms of 2/10, net 30. However, the invoice might be dated May 1 so that the credit period actually begins at that time. This practice encourages buyers to order early.

Length of the Credit Period Several factors influence the length of the credit period. Two important ones are the *buyer's* inventory period and operating cycle. All else equal, the shorter these are, the shorter the credit period will be.

As discussed in Chapter 18, the operating cycle has two components: The inventory period and the receivables period. The buyer's inventory period is the time it takes the buyer to acquire inventory (from us), process it, and sell it. The buyer's receivables period is the time it then takes the buyer to collect on the sale. Note that the credit period we offer is effectively the buyer's payables period.

By extending credit, we finance a portion of our buyer's operating cycle and thereby shorten that buyer's cash cycle (see Figure 18.1). If our credit period exceeds the buyer's inventory period, then we are financing not only the buyer's inventory purchases, but part of the buyer's receivables as well.

If our credit period exceeds our buyer's operating cycle, then we are effectively providing financing for aspects of our customer's business beyond the immediate purchase and sale of our merchandise. The reason is that the buyer effectively has a loan from us even after the merchandise is resold, and the buyer can use that credit for other purposes. For this reason, the length of the buyer's operating cycle is often cited as an appropriate upper limit to the credit period.

There are a number of other factors that influence the credit period. Many of these also influence our customer's operating cycles; so, once again, these are related subjects. Among the most important are these:

1. *Perishability and collateral value:* Perishable items have relatively rapid turnover and relatively low collateral value. Credit periods are shorter for such goods. A food wholesaler selling fresh fruit and produce might use net seven days. Alternatively, jewelry might be sold for 5/30, net four months.
2. *Consumer demand:* Products that are well established generally have more rapid turnover. Newer or slow-moving products will often have longer credit periods associated with them to entice buyers. Also, as we have seen, sellers may choose to extend much longer credit periods for off-season sales (when customer demand is low).
3. *Cost, profitability, and standardization:* Relatively inexpensive goods tend to have shorter credit periods. The same is true for relatively standardized goods and raw materials. These all tend to have lower markups and higher turnover rates, both of which lead to shorter credit periods. There are exceptions. Auto dealers, for example, generally pay for cars as they are received.
4. *Credit risk:* The greater the credit risk of the buyer, the shorter the credit period is likely to be (if credit is granted at all).
5. *Size of the account:* If an account is small, the credit period may be shorter because small accounts cost more to manage, and the customers are less important.
6. *Competition:* When the seller is in a highly competitive market, longer credit periods may be offered as a way of attracting customers.
7. *Customer type:* A single seller might offer different credit terms to different buyers. A food wholesaler might supply groceries, bakeries, and restaurants. Each group would probably have different credit terms. More generally, sellers often have both wholesale and retail customers, and they frequently quote different terms to the two types.

CASH DISCOUNTS

As we have seen, **cash discounts** are often part of the terms of sale. The practice of granting discounts for cash purchases in the United States dates to the Civil War and is widespread today. One reason discounts are offered is to speed up the collection of receivables. This will have the effect of reducing the amount of credit being offered, and the firm must trade this off against the cost of the discount.

cash discount

A discount given to induce prompt payment. Also called a *sales discount*.

Notice that when a cash discount is offered, the credit is essentially free during the discount period. The buyer pays for the credit only after the discount expires. With 2/10, net 30, a rational buyer either pays in 10 days to make the greatest possible use of the free credit or pays in 30 days to get the longest possible use of the money in exchange for giving up the discount. By giving up the discount, the buyer effectively gets $30 - 10 = 20$ days' credit.

Another reason for cash discounts is that they are a way of charging higher prices to customers that have had credit extended to them. In this sense, cash discounts are a convenient way of charging for the credit granted to customers.



Visit the National Association
of Credit Management at
www.nacm.org

Cost of the Credit In our examples, it might seem that the discounts are rather small. With 2/10, net 30, early payment gets the buyer only a 2 percent discount. Does this provide a significant incentive for early payment? The answer is yes because the implicit interest rate is extremely high.

To see why the discount is important, we will calculate the cost to the buyer of not paying early. To do this, we will find the interest rate that the buyer is effectively paying for the trade credit. Suppose the order is for \$1,000. The buyer can pay \$980 in 10 days or wait another 20 days and pay \$1,000. It's obvious that the buyer is effectively borrowing \$980 for 20 days and that the buyer pays \$20 in interest on the "loan." What's the interest rate?

This interest is ordinary discount interest, which we discussed in Chapter 5. With \$20 in interest on \$980 borrowed, the rate is $\$20/\$980 = .020408$, or 2.0408%. This is relatively low, but remember that this is the rate per 20-day period. There are $365/20 = 18.25$ such periods in a year; so, by not taking the discount, the buyer is paying an effective annual rate (EAR) of:

$$\text{EAR} = 1.020408^{18.25} - 1 = .4459, \text{ or } 44.59\%$$

From the buyer's point of view, this is an expensive source of financing!

Given that the interest rate is so high, it is unlikely that the seller benefits from early payment. Ignoring the possibility of default by the buyer, the decision of a customer to forgo the discount almost surely works to the seller's advantage.

Trade Discounts In some circumstances, the discount is not really an incentive for early payment but is instead a *trade discount*, a discount routinely given to some type of buyer. With our 2/10th, EOM terms, the buyer takes a 2 percent discount if the invoice is paid by the 10th, but the bill is considered due on the 10th, and overdue after that. In this case, the credit period and the discount period are effectively the same, and there is no reward for paying before the due date.

The Cash Discount and the ACP To the extent that a cash discount encourages customers to pay early, it will shorten the receivables period and, all other things being equal, reduce the firm's investment in receivables.

Suppose a firm currently has terms of net 30 and an ACP of 30 days. If it offers terms of 2/10, net 30, then perhaps 50 percent of its customers (in terms of volume of purchases) will pay in 10 days. The remaining customers will still take an average of 30 days to pay. What will the new ACP be? If the firm's annual sales are \$15 million (before discounts), what will happen to the investment in receivables?

If half of the customers take 10 days to pay and half take 30, then the new average collection period will be:

$$\text{New ACP} = .50 \times 10 \text{ days} + .50 \times 30 \text{ days} = 20 \text{ days}$$

The ACP falls from 30 days to 20 days. Average daily sales are $\$15 \text{ million}/365 = \$41,096$ per day. Receivables will fall by $\$41,096 \times 10 = \$410,959$.

CREDIT INSTRUMENTS

The **credit instrument** is the basic evidence of indebtedness. Most trade credit is offered on *open account*. This means that the only formal instrument of credit is the invoice, which is sent with the shipment of goods and which the customer signs as evidence that the goods have been received. Afterward, the firm and its customers record the exchange on their books of account.

credit instrument
The evidence of indebtedness.

At times, the firm may require that the customer sign a *promissory note*. This is a basic IOU and might be used when the order is large, when there is no cash discount involved, or when the firm anticipates a problem in collections. Promissory notes are uncommon, but they can eliminate possible controversies later about the existence of debt.

One problem with promissory notes is that they are signed after delivery of the goods. One way to obtain a credit commitment from a customer before the goods are delivered is to arrange a *commercial draft*. Typically, the firm draws up a commercial draft calling for the customer to pay a specific amount by a specified date. The draft is then sent to the customer's bank with the shipping invoices.

If immediate payment is required on the draft, it is called a *sight draft*. If immediate payment is not required, then the draft is a *time draft*. When the draft is presented and the buyer "accepts" it, meaning that the buyer promises to pay it in the future, then it is called a *trade acceptance* and it is sent back to the selling firm. The seller can then keep the acceptance or sell it to someone else. If a bank accepts the draft, meaning that the bank is guaranteeing payment, then the draft becomes a *banker's acceptance*. This arrangement is common in international trade, and banker's acceptances are actively traded in the money market.

A firm can also use a conditional sales contract as a credit instrument. With such an arrangement, the firm retains legal ownership of the goods until the customer has completed payment. Conditional sales contracts usually are paid in installments and have an interest cost built into them.

Concept Questions

- 20.2a** What considerations enter into the determination of the terms of sale?
20.2b Explain what terms of "3/45, net 90" mean. What is the effective interest rate?

Analyzing Credit Policy

20.3

In this section, we take a closer look at the factors that influence the decision to grant credit. Granting credit makes sense only if the NPV from doing so is positive. We need to look at the NPV of the decision to grant credit.

CREDIT POLICY EFFECTS

In evaluating credit policy, there are five basic factors to consider:

1. *Revenue effects*: If the firm grants credit, then there will be a delay in revenue collections as some customers take advantage of the credit offered and pay later. However, the firm may be able to charge a higher price if it grants credit and it may be able to increase the quantity sold. This may increase total revenues.
2. *Cost effects*: Although the firm may experience delayed revenues if it grants credit, it will still incur the costs of sales immediately. Whether the firm sells for cash or credit, it will still have to acquire or produce the merchandise (and pay for it).

3. *The cost of debt:* When the firm grants credit, it must arrange to finance the resulting receivables. As a result, the firm's cost of short-term borrowing is a factor in the decision to grant credit.¹
4. *The probability of nonpayment:* If the firm grants credit, some percentage of the credit buyers will not pay. This can't happen, of course, if the firm sells for cash.
5. *The cash discount:* When the firm offers a cash discount as part of its credit terms, some customers will choose to pay early to take advantage of the discount.

EVALUATING A PROPOSED CREDIT POLICY

To illustrate how credit policy can be analyzed, we will start with a relatively simple case. Locust Software has been in existence for two years, and it is one of several successful firms that develop computer programs. Currently, Locust sells for cash only.

Locust is evaluating a request from some major customers to change its current policy to net one month (30 days). To analyze this proposal, we define the following:

P = Price per unit

v = Variable cost per unit

Q = Current quantity sold per month

Q' = Quantity sold under new policy

R = Monthly required return

For now, we ignore discounts and the possibility of default. Also, we ignore taxes because they don't affect our conclusions.

NPV of Switching Policies To illustrate the NPV of switching credit policies, suppose we have the following for Locust:

P = \$49

v = \$20

Q = 100

Q' = 110

If the required return, R , is 2 percent per month, should Locust make the switch?

Currently, Locust has monthly sales of $P \times Q$ = \$4,900. Variable costs each month are $v \times Q$ = \$2,000, so the monthly cash flow from this activity is:

$$\text{Cash flow with old policy} = (P - v)Q$$

$$= (\$49 - 20) \times 100$$

$$= \$2,900$$

20.2

This is not the total cash flow for Locust, of course, but it is all that we need to look at because fixed costs and other components of cash flow are the same whether or not the switch is made.

If Locust does switch to net 30 days on sales, then the quantity sold will rise to $Q' = 110$. Monthly revenues will increase to $P \times Q'$, and costs will be $v \times Q'$. The monthly cash flow

¹The cost of short-term debt is not necessarily the required return on receivables, although it is commonly assumed to be. As always, the required return on an investment depends on the risk of the investment, not the source of the financing. The *buyer's* cost of short-term debt is closer in spirit to the correct rate. We will maintain the implicit assumption that the seller and the buyer have the same short-term debt cost. In any case, the time periods in credit decisions are relatively short, so a relatively small error in the discount rate will not have a large effect on our estimated NPV.

under the new policy will be:

$$\begin{aligned}\text{Cash flow with new policy} &= (P - v)Q' \\ &= (\$49 - 20) \times 110 \\ &= \$3,190\end{aligned}$$

20.3

Going back to Chapter 10, we know that the relevant incremental cash flow is the difference between the new and old cash flows:

$$\begin{aligned}\text{Incremental cash inflow} &= (P - v)(Q' - Q) \\ &= (\$49 - 20) \times (110 - 100) \\ &= \$290\end{aligned}$$

This says that the benefit each month of changing policies is equal to the gross profit per unit sold, $P - v = \$29$, multiplied by the increase in sales, $Q' - Q = 10$. The present value of the future incremental cash flows is:

$$PV = [(P - v)(Q' - Q)]/R$$

20.4

For Locust, this present value works out to be:

$$PV = (\$29 \times 10)/.02 = \$14,500$$

Notice that we have treated the monthly cash flow as a perpetuity because the same benefit will be realized each month forever.

Now that we know the benefit of switching, what's the cost? There are two components to consider. First, because the quantity sold will rise from Q to Q' , Locust will have to produce $Q' - Q$ more units at a cost of $v(Q' - Q) = \$20 \times (110 - 100) = \200 . Second, the sales that would have been collected this month under the current policy ($P \times Q = \$4,900$) will not be collected. Under the new policy, the sales made this month won't be collected until 30 days later. The cost of the switch is the sum of these two components:

$$\text{Cost of switching} = PQ + v(Q' - Q)$$

20.5

For Locust, this cost would be $\$4,900 + 200 = \$5,100$.

Putting it all together, we see that the NPV of the switch is:

$$NPV \text{ of switching} = -[PQ + v(Q' - Q)] + [(P - v)(Q' - Q)]/R$$

20.6

For Locust, the cost of switching is $\$5,100$. As we saw earlier, the benefit is $\$290$ per month forever. At 2 percent per month, the NPV is:

$$\begin{aligned}NPV &= -\$5,100 + \$290/.02 \\ &= -\$5,100 + 14,500 \\ &= \$9,400\end{aligned}$$

Therefore, the switch is profitable.

We'd Rather Fight Than Switch

EXAMPLE 20.1

Suppose a company is considering a switch from all cash to net 30, but the quantity sold is not expected to change. What is the NPV of the switch? Explain.

In this case, $Q' - Q$ is zero, so the NPV is $-PQ$. What this says is that the effect of the switch is to postpone one month's collections forever, with no benefit from doing so.

A Break-Even Application Based on our discussion thus far, the key variable for Locust is $Q' - Q$, the increase in unit sales. The projected increase of 10 units is only an estimate, so there is some forecasting risk. Under the circumstances, it's natural to wonder what increase in unit sales is necessary to break even.

Earlier, the NPV of the switch was defined as:

$$\text{NPV} = -[PQ + v(Q' - Q)] + [(P - v)(Q' - Q)]/R$$

We can calculate the break-even point explicitly by setting the NPV equal to zero and solving for $(Q' - Q)$:

$$\text{NPV} = 0 = -[PQ + v(Q' - Q)] + [(P - v)(Q' - Q)]/R \quad 20.7$$

$$Q' - Q = PQ/[(P - v)/R - v]$$

For Locust, the break-even sales increase is:

$$\begin{aligned} Q' - Q &= \$4,900/(\$29.02 - \$20) \\ &= 3.43 \text{ units} \end{aligned}$$

This tells us that the switch is a good idea as long as Locust is confident that it can sell at least 3.43 more units per month.

Concept Questions

20.3a What are the important effects to consider in a decision to offer credit?

20.3b Explain how to estimate the NPV of a credit policy switch.

20.4 Optimal Credit Policy

So far, we've discussed how to compute net present values for a switch in credit policy. We have not discussed the optimal amount of credit or the optimal credit policy. In principle, the optimal amount of credit is determined by the point at which the incremental cash flows from increased sales are exactly equal to the incremental costs of carrying the increased investment in accounts receivable.

THE TOTAL CREDIT COST CURVE

The trade-off between granting credit and not granting credit isn't hard to identify, but it is difficult to quantify precisely. As a result, we can only describe an optimal credit policy.

To begin, the carrying costs associated with granting credit come in three forms:

1. The required return on receivables.
2. The losses from bad debts.
3. The costs of managing credit and credit collections.

We have already discussed the first and second of these. The third cost, the cost of managing credit, consists of the expenses associated with running the credit department. Firms that don't grant credit have no such department and no such expense. These three costs will all increase as credit policy is relaxed.

If a firm has a very restrictive credit policy, then all of the associated costs will be low. In this case, the firm will have a "shortage" of credit, so there will be an opportunity cost.

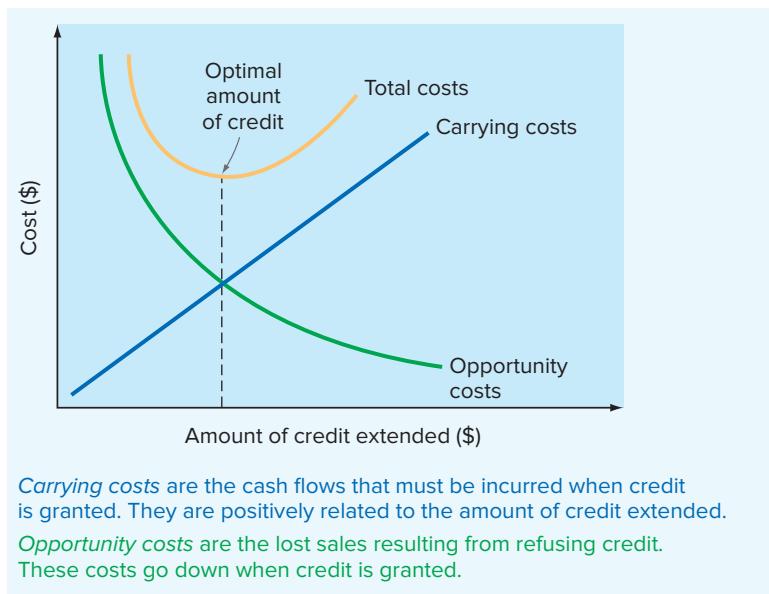


FIGURE 20.1
The Costs of Granting Credit

This opportunity cost is the extra potential profit from credit sales that are lost because credit is refused. This forgone benefit comes from two sources: The increase in quantity sold, Q' minus Q , and (potentially) a higher price. The opportunity costs go down as credit policy is relaxed.

The sum of the carrying costs and the opportunity costs of a particular credit policy is called the total **credit cost curve**. We have drawn such a curve in Figure 20.1. As Figure 20.1 illustrates, there is a point where the total credit cost is minimized. This point corresponds to the optimal amount of credit or, equivalently, the optimal investment in receivables.

If the firm extends more credit than this minimum, the additional net cash flow from new customers will not cover the carrying costs of the investment in receivables. If the level of receivables is below this amount, then the firm is forgoing valuable profit opportunities.

In general, the costs and benefits from extending credit will depend on the characteristics of particular firms and industries. All other things being equal, it is likely that firms with (1) excess capacity, (2) low variable operating costs, and (3) repeat customers will extend credit more liberally than other firms. See if you can explain why each of these characteristics contributes to a more liberal credit policy.

credit cost curve
A graphical representation of the sum of the carrying costs and the opportunity costs of a credit policy.

ORGANIZING THE CREDIT FUNCTION

Firms that grant credit have the expense of running a credit department. In practice, firms often choose to contract out all or part of the credit function to a factor, an insurance company, or a captive finance company. Chapter 18 discusses factoring, an arrangement in which the firm sells its receivables. Depending on the specific arrangement, the factor may have full responsibility for credit checking, authorization, and collection. Smaller firms may find such an arrangement cheaper than running a credit department.

Firms that manage internal credit operations are self-insured against default. An alternative is to buy credit insurance through an insurance company. The insurance company offers coverage up to a preset dollar limit for each account. As you would expect, accounts with a higher credit rating merit higher insurance limits. This type of insurance is particularly important for exporters, and government insurance is available for certain types of exports.

captive finance company

A wholly owned subsidiary that handles the credit function for the parent company.

Large firms often extend credit through a **captive finance company**, which is a wholly owned subsidiary that handles the credit function for the parent company. Ford Motor Credit (FMC) is a well-known example. Ford sells to car dealers, who in turn sell to customers. FMC finances a dealer's inventory of cars and also finances customers who buy the cars.

Why would a firm choose to set up a separate company to handle the credit function? There are a number of reasons, but a primary one is to separate the production and financing of the firm's products for management, financing, and reporting. The finance subsidiary can borrow in its own name, using its receivables as collateral, and the subsidiary often carries a better credit rating than the parent. This may allow the firm to achieve a lower overall cost of debt than could be obtained if production and financing were commingled.

Concept Questions

- 20.4a** What are the carrying costs of granting credit?
- 20.4b** What are the opportunity costs of not granting credit?
- 20.4c** What is a captive finance company?

20.5 Credit Analysis

Thus far, we have focused on establishing credit terms. Once a firm decides to grant credit to its customers, it must then establish guidelines for determining who will and who will not be allowed to buy on credit. *Credit analysis* refers to the process of deciding whether or not to extend credit to a particular customer. It usually involves two steps: Gathering relevant information and determining creditworthiness.

Credit analysis is important because potential losses on receivables can be substantial. Companies report the amount of receivables they do not expect to collect on their balance sheets. In late 2017, IBM reported that \$689 million of accounts receivable were doubtful, and Microsoft reported \$285 million as an allowance for losses.

WHEN SHOULD CREDIT BE GRANTED?

Imagine that a firm is trying to decide whether or not to grant credit to a customer. This decision can get complicated. Note that the answer depends on what will happen if credit is refused. Will the customer pay cash? Or will the customer not make the purchase at all? To avoid being bogged down by this and other difficulties, we will use some special cases to illustrate the key points.

A One-Time Sale We start by considering the simplest case. A new customer wishes to buy one unit on credit at a price of P per unit. If credit is refused, the customer will not make the purchase.

Furthermore, we assume that, if credit is granted, then, in one month, the customer will either pay up or default. The probability of the second of these events is π . In this case, the probability (π) can be interpreted as the percentage of *new* customers who will not pay. Our business does not have repeat customers, so this is strictly a one-time sale. Finally, the required return on receivables is R per month, and the variable cost is v per unit.

The analysis here is straightforward. If the firm refuses credit, then the incremental cash flow is zero. If it grants credit, then it spends v (the variable cost) this month and expects to collect $(1 - \pi)P$ next month. The NPV of granting credit is:

$$\text{NPV} = -v + (1 - \pi)P/(1 + R)$$

20.8

For Locust Software, this NPV is:

$$\text{NPV} = -\$20 + (1 - \pi) \times \$49/1.02$$

With, say, a 20 percent rate of default, this works out to be:

$$\text{NPV} = -\$20 + .80 \times \$49/1.02 = \$18.43$$

Therefore, credit should be granted. Notice that we have divided by $(1 + R)$ here instead of by R because we now assume that this is a one-time transaction.

Our example illustrates an important point. In granting credit to a new customer, a firm risks its variable cost (v). It stands to gain the full price (P). For a new customer, then, credit may be granted even if the default probability is high. The break-even probability in this case can be determined by setting the NPV equal to zero and solving for π :

$$\text{NPV} = 0 = -\$20 + (1 - \pi) \times \$49/1.02$$

$$1 - \pi = \$20/\$49 \times 1.02$$

$$\pi = .584, \text{ or } 58.4\%$$

Locust should extend credit as long as there is a $1 - .584 = .416$, or 41.6% chance or better of collecting. This explains why firms with higher markups tend to have looser credit terms.

This percentage (58.4%) is the maximum acceptable default probability for a *new* customer. If a returning, cash-paying customer wanted to switch to a credit basis, the analysis would be different, and the maximum acceptable default probability would be much lower.

The important difference is that if we extend credit to a returning customer, then we risk the total sales price (P), because this is what we collect if we don't extend credit. If we extend credit to a new customer, then we risk only our variable cost.

Repeat Business A second, very important factor to keep in mind is the possibility of repeat business. We can illustrate this by extending our one-time sale example. We make one important assumption: A new customer who does not default the first time around will remain a customer forever and never default.

If the firm grants credit, it spends v this month. Next month, it gets nothing if the customer defaults, or it gets P if the customer pays. If the customer pays, then the customer will buy another unit on credit and the firm will spend v again. The net cash inflow for the month is $P - v$. In every subsequent month, this same $P - v$ will occur as the customer pays for the previous month's order and places a new one.

It follows from our discussion that, in one month, the firm will receive \$0 with probability π . With probability $(1 - \pi)$ the firm will have a permanent new customer. The value of a new customer is equal to the present value of $(P - v)$ every month forever:

$$\text{PV} = (P - v)/R$$

The NPV of extending credit is:

$$\text{NPV} = -v + (1 - \pi)(P - v)/R$$

20.9

For Locust, this is:

$$\begin{aligned}\text{NPV} &= -\$20 + (1 - \pi) \times (\$49 - 20)/.02 \\ &= -\$20 + (1 - \pi) \times \$1,450\end{aligned}$$

Even if the probability of default is 90 percent, the NPV is:

$$NPV = -\$20 + .10 \times \$1,450 = \$125$$

Locust should extend credit unless default is a virtual certainty. The reason is that it costs only \$20 to find out who is a good customer and who is not. A good customer is worth \$1,450, so Locust can afford quite a few defaults.

Our repeat business example probably exaggerates the acceptable default probability, but it does illustrate that it will often turn out that the best way to do credit analysis is to extend credit to almost anyone. It also points out that the possibility of repeat business is a crucial consideration. In such cases, the important thing is to control the amount of credit initially offered to any one customer so that the possible loss is limited. The amount can be increased with time. Most often, the best predictor of whether or not someone will pay in the future is whether or not they have paid in the past.

CREDIT INFORMATION



Web-surfing students should peruse the Dun & Bradstreet home page. This major supplier of credit information can be found at www.dnb.com.

If a firm wants credit information about customers, there are a number of sources. Information sources commonly used to assess creditworthiness include the following:

1. *Financial statements:* A firm can ask a customer to supply financial statements such as balance sheets and income statements. Minimum standards and rules of thumb based on financial ratios like the ones we discussed in Chapter 3 can then be used as a basis for extending or refusing credit.
2. *Credit reports about the customer's payment history with other firms:* Quite a few organizations sell information about the credit strength and credit history of business firms. The best-known and largest firm of this type is Dun & Bradstreet, which provides subscribers with credit reports on individual firms. Experian is another well-known credit-reporting firm. Ratings and information are available for a huge number of firms, including very small ones. Equifax, TransUnion, and Experian are the major suppliers of consumer credit information.
3. *Banks:* Banks will generally provide some assistance to their business customers in acquiring information about the creditworthiness of other firms.
4. *The customer's payment history with the firm:* The most obvious way to obtain information about the likelihood of customers not paying is to examine whether they have settled past obligations (and how quickly).

CREDIT EVALUATION AND SCORING

There are no magical formulas for assessing the probability that a customer will not pay. In very general terms, the classic **five Cs of credit** are the basic factors to be evaluated:

1. *Character:* The customer's willingness to meet credit obligations.
2. *Capacity:* The customer's ability to meet credit obligations out of operating cash flows.
3. *Capital:* The customer's financial reserves.
4. *Collateral:* An asset pledged in the case of default.
5. *Conditions:* General economic conditions in the customer's line of business.

five Cs of credit

The five basic credit factors to be evaluated: Character, capacity, capital, collateral, and conditions.

credit scoring

The process of quantifying the probability of default when granting consumer credit.

Credit scoring is the process of calculating a numerical rating for a customer based on information collected; credit is then granted or refused based on the result. A firm might rate a customer on a scale of 1 (very poor) to 10 (very good) on each of the five Cs of credit using all the information available about the customer. A credit score could then

be calculated by totaling these ratings. Based on experience, a firm might choose to grant credit only to customers with a score above, say, 30.

Firms such as credit card issuers have developed statistical models for credit scoring. Usually, all of the legally relevant and observable characteristics of a large pool of customers are studied to find their historic relation to defaults. Based on the results, it is possible to determine the variables that best predict whether a customer will pay and then calculate a credit score based on those variables.

Because credit-scoring models and procedures determine who is and who is not creditworthy, it is not surprising that they have been the subject of government regulation. In particular, the kinds of background and demographic information that can be used in the credit decision are limited.

Concept Questions

20.5a What is credit analysis?

20.5b What are the five Cs of credit?

Collection Policy

20.6

Collection policy, the final element in credit policy, involves monitoring receivables to spot trouble and obtaining payment on past-due accounts.

MONITORING RECEIVABLES

To keep track of payments by customers, most firms will monitor outstanding accounts. First of all, a firm will normally keep track of its ACP through time. If a firm is in a seasonal business, the ACP will fluctuate during the year; but unexpected increases in the ACP are a cause for concern. Either customers in general are taking longer to pay, or some percentage of accounts receivable are seriously overdue.

The **aging schedule** is a second basic tool for monitoring receivables. To prepare one, the credit department classifies accounts by age.² Suppose a firm has \$100,000 in receivables. Some of these accounts are only a few days old, but others have been outstanding for quite some time. The following is an example of an aging schedule:

aging schedule
A compilation of accounts receivable by the age of each account.

Aging Schedule		
Age of Account	Amount	Percentage of Total Value of Accounts Receivable
0–10 days	\$ 50,000	50%
11–60 days	25,000	25
61–80 days	20,000	20
Over 80 days	5,000	5
	\$100,000	100%

If this firm has a credit period of 60 days, then 25 percent of its accounts are late. Whether or not this is serious depends on the nature of the firm's collections and customers. It is often the case that accounts beyond a certain age are almost never collected. Monitoring the age of accounts is very important in such cases.

²Aging schedules are also used elsewhere in business, such as inventory tracking.

For firms with seasonal sales, the percentages on the aging schedule will change during the year. If sales in the current month are very high, then total receivables will also increase sharply. This means that the older accounts, as a percentage of total receivables, become smaller and might appear less important. Some firms have refined the aging schedule so that they have an idea of how it should change in relation to the peaks and valleys in their sales.

COLLECTION EFFORT

A firm usually goes through the following sequence of procedures for customers whose payments are overdue:

1. It sends out a delinquency letter informing the customer of the past-due status of the account.
2. It makes a telephone call to the customer.
3. It employs a collection agency.
4. It takes legal action against the customer.

At times, a firm may refuse to grant additional credit to customers until arrearages are cleared up. This may antagonize a normally good customer, which points to a potential conflict between the collections department and the sales department.

In probably the worst case, the customer files for bankruptcy. When this happens, the credit-granting firm is just another unsecured creditor. The firm can wait, or it can sell its receivable. For example, when retailer Sports Authority filed for bankruptcy in 2016, it had more than \$1 billion in debt, with less than \$50,000 in assets listed. Two of its larger suppliers were Nike and Under Armour, to which it owed \$48 million and \$23 million, respectively.

Concept Questions

20.6a What tools can a manager use to monitor receivables?

20.6b What is an aging schedule?

20.7 Inventory Management

Like receivables, inventories represent a significant investment for many firms. For a typical manufacturing operation, inventories will often exceed 15 percent of assets. For a retailer, inventories could represent more than 25 percent of assets. From our discussion in Chapter 18, we know that a firm's operating cycle is made up of its inventory period and its receivables period. This is one reason for considering credit and inventory policy in the same chapter. Beyond this, both credit policy and inventory policy are used to drive sales, and the two must be coordinated to ensure that the process of acquiring inventory, selling it, and collecting on the sale all proceed smoothly. Changes in credit policy designed to stimulate sales must be accompanied by planning for adequate inventory.

THE FINANCIAL MANAGER AND INVENTORY POLICY

Despite the size of a typical firm's investment in inventories, the financial manager of a firm will not normally have primary control over inventory management. Instead, other

functional areas such as purchasing, production, and marketing will usually share decision-making authority regarding inventory. Inventory management has become an increasingly important specialty in its own right, and financial management will often only have input into the decision. For this reason, we will survey some basics of inventory and inventory policy.



Visit the Society for Inventory Management Benchmarking Analysis at www.simba.org.

INVENTORY TYPES

For a manufacturer, inventory is normally classified into one of three categories. The first category is *raw material*. This is whatever the firm uses as a starting point in its production process. Raw materials might be something as basic as iron ore for a steel manufacturer or something as sophisticated as disk drives for a computer manufacturer.

The second type of inventory is *work-in-progress*, which is what the name suggests—an unfinished product. How big this portion of inventory is depends in large part on the length of the production process. For an airframe manufacturer, work-in-progress can be substantial. The third and final type of inventory is *finished goods*—that is, products ready to ship or sell.

Keep in mind three things concerning inventory types. First, the names for the different types of inventory can be a little misleading because one company's raw materials can be another's finished goods. Going back to our steel manufacturer, iron ore would be a raw material, and steel would be the final product. An auto body panel stamping operation will have steel as its raw material and auto body panels as its finished goods, and an automobile assembler will have auto body panels as raw materials and automobiles as finished products.

The second thing to keep in mind is that the various types of inventory can be quite different in terms of their liquidity. Raw materials that are commodity-like or relatively standardized can be easy to convert to cash. Work-in-progress, on the other hand, can be quite illiquid and have little more than scrap value. As always, the liquidity of finished goods depends on the nature of the product.

Finally, a very important distinction between finished goods and other types of inventories is that the demand for an inventory item that becomes a part of another item is usually termed *derived* or *dependent demand* because the firm's need for these inventory types depends on its need for finished items. In contrast, the firm's demand for finished goods is not derived from demand for other inventory items, so it is sometimes said to be *independent*.

INVENTORY COSTS

As we discussed in Chapter 18, two basic types of costs are associated with current assets in general and with inventory in particular. The first of these is *carrying costs*. Here, carrying costs represent all of the direct and opportunity costs of keeping inventory on hand. These include:

1. Storage and tracking costs.
2. Insurance and taxes.
3. Losses due to obsolescence, deterioration, or theft.
4. The opportunity cost of capital on the invested amount.

The sum of these costs can be substantial, ranging roughly from 20 to 40 percent of inventory value per year.

The second type of cost associated with inventory is *shortage costs*. Shortage costs are costs associated with having inadequate inventory on hand. The two components of shortage costs are restocking costs and costs related to safety reserves. Depending on the firm's business, restocking or order costs are either the costs of placing an order with suppliers or the costs of setting up a production run. The costs related to safety reserves are opportunity

costs such as lost sales and loss of customer goodwill that result from having inadequate inventory.

A basic trade-off exists in inventory management because carrying costs increase with inventory levels, whereas shortage or restocking costs decline with inventory levels. The basic goal of inventory management is to minimize the sum of these two costs. We consider ways to reach this goal in the next section.

To give you an idea of how important it is to balance carrying costs with shortage costs, consider the delay in deliveries for a wide variety of companies that we discussed at the beginning of the chapter. The companies all faced shortages and either lost sales or were forced to resort to more expensive shipping methods.

Concept Questions

- 20.7a** What are the different types of inventory?
- 20.7b** What are three things to remember when examining inventory types?
- 20.7c** What is the basic goal of inventory management?

20.8 Inventory Management Techniques

As we described earlier, the goal of inventory management is usually framed as cost minimization. Three techniques are discussed in this section, ranging from the relatively simple to the very complex.

THE ABC APPROACH

The ABC approach is a simple approach to inventory management in which the basic idea is to divide inventory into three (or more) groups. The underlying rationale is that a small portion of inventory in terms of quantity might represent a large portion in terms of inventory value. This situation would exist for a manufacturer that uses some relatively expensive, high-tech components and some relatively inexpensive basic materials in producing its products.

Figure 20.2 illustrates an ABC comparison of items in terms of the percentage of inventory value represented by each group versus the percentage of items represented. As Figure 20.2 shows, the A Group comprises only 10 percent of inventory by item count, but it represents over half of the value of inventory. The A Group items are monitored closely, and inventory levels are kept relatively low. At the other end, basic inventory items, such as nuts and bolts, also exist; because these are crucial and inexpensive, large quantities are ordered and kept on hand. These would be C Group items. The B Group is made up of in-between items.

THE ECONOMIC ORDER QUANTITY MODEL

The economic order quantity (EOQ) model is the best-known approach for explicitly establishing an optimal inventory level. The basic idea is illustrated in Figure 20.3, which plots the various costs associated with holding inventory (on the vertical axis) against inventory levels (on the horizontal axis). As shown, inventory carrying costs rise and restocking costs decrease as inventory levels increase. From our general discussion in Chapter 18 and our

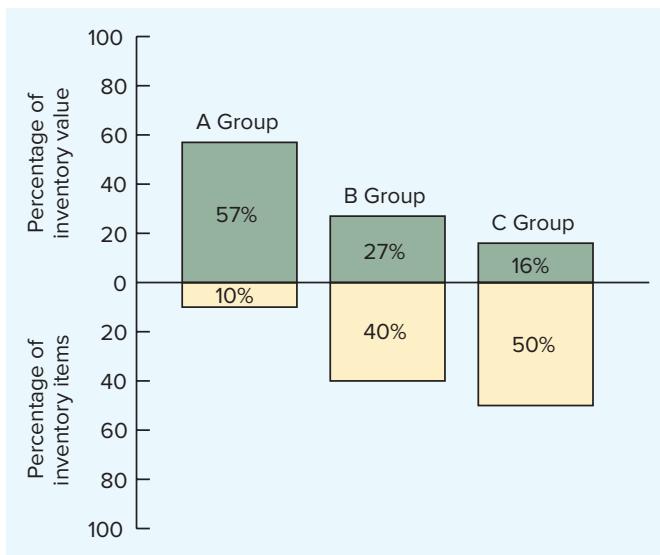


FIGURE 20.2
ABC Inventory Analysis

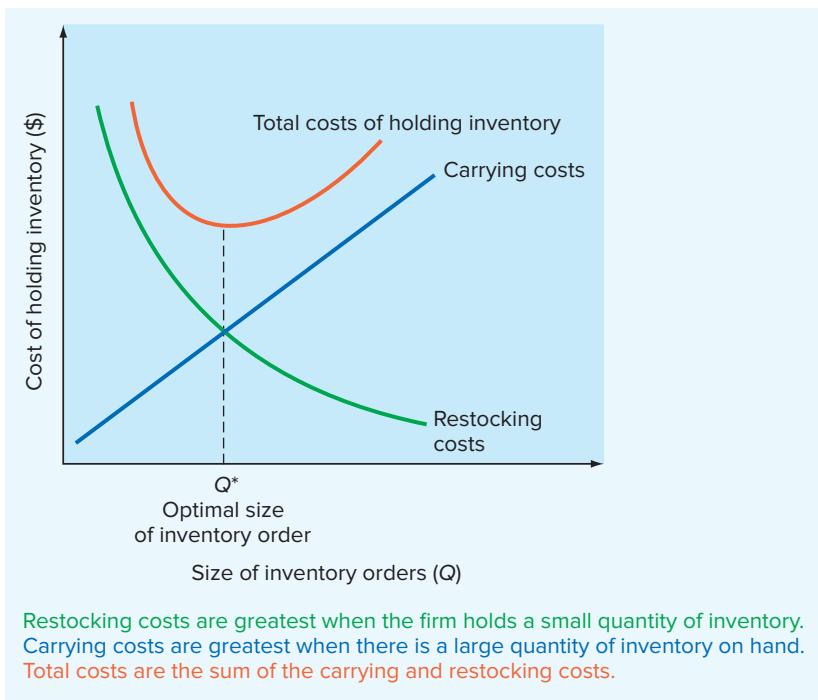


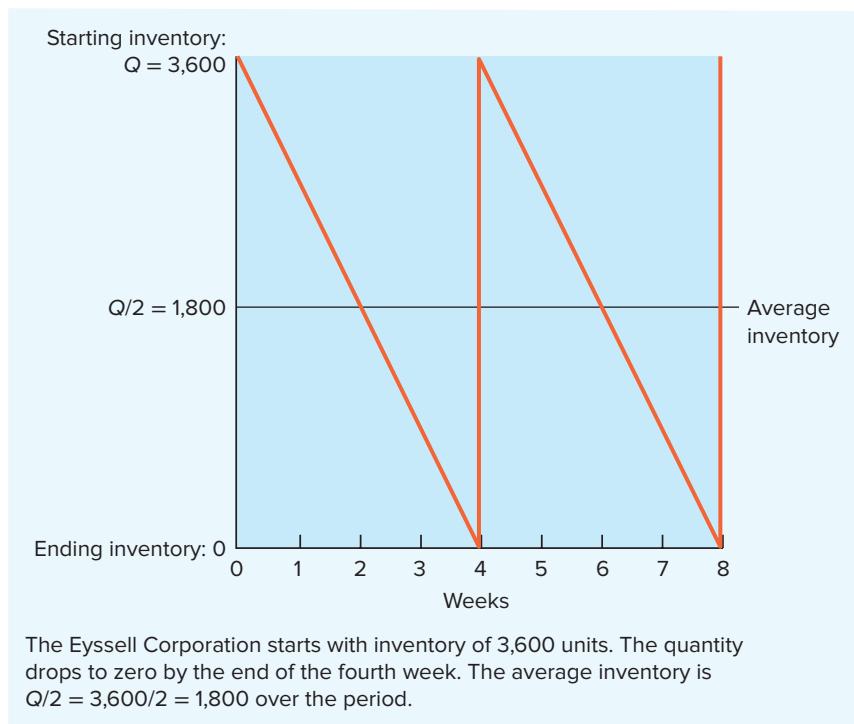
FIGURE 20.3
Costs of Holding Inventory

discussion of the total credit cost curve in this chapter, the general shape of the total inventory cost curve is familiar. With the EOQ model, we will attempt to specifically locate the minimum total cost point, Q^* .

In our discussion that follows, an important point to keep in mind is that the actual cost of the inventory itself is not included. The reason is that the *total* amount of inventory the firm needs in a given year is dictated by sales. What we are analyzing here is how much the firm should have on hand at any particular time. More precisely, we are trying to determine what order size the firm should use when it restocks its inventory.

FIGURE 20.4

Inventory Holdings for the Eyssell Corporation



Inventory Depletion To develop the EOQ, we will assume that the firm's inventory is sold at a steady rate until it hits zero. At that point, the firm restocks its inventory back to some optimal level. Suppose the Eyssell Corporation starts out today with 3,600 units of a particular item in inventory. Annual sales of this item are 46,800 units, which is about 900 per week. If Eyssell sells off 900 units of inventory each week, then all the available inventory will be sold after four weeks, and Eyssell will restock by ordering (or manufacturing) another 3,600 units and start over. This selling and restocking process produces a sawtooth pattern for inventory holdings; this pattern is illustrated in Figure 20.4. As the figure shows, Eyssell always starts with 3,600 units in inventory and ends up at zero. On average, then, inventory is half of 3,600, or 1,800 units.

The Carrying Costs As Figure 20.3 illustrates, carrying costs are normally assumed to be directly proportional to inventory levels. Suppose we let Q be the quantity of inventory that Eyssell orders each time (3,600 units); we will call this the *restocking quantity*. Average inventory would then be $Q/2$, or 1,800 units. If we let CC be the carrying cost per unit per year, Eyssell's total carrying costs will be:

$$\begin{aligned}\text{Total carrying costs} &= \text{Average inventory} \times \text{Carrying cost per unit} \\ &= (Q/2) \times CC\end{aligned}$$

20.10

In Eyssell's case, if carrying costs were \$.75 per unit per year, total carrying costs would be the average inventory of 1,800 units multiplied by \$.75, or \$1,350 per year.

The Restocking Costs For now, we will focus only on the restocking costs. In essence, we will assume that the firm never actually runs short on inventory, so that costs relating to safety reserves are unimportant. We will return to this issue later.

Restocking costs are normally assumed to be fixed. In other words, every time we place an order, fixed costs are associated with that order (remember that the cost of the inventory itself is not considered here). Suppose we let T be the firm's total unit sales per year. If the firm orders Q units each time, then it will need to place a total of T/Q orders. For Eyssell, annual sales are 46,800, and the order size is 3,600. Eyssel places a total of $46,800/3,600 = 13$ orders per year. If the fixed cost per order is F , the total restocking cost for the year would be:

$$\begin{aligned}\text{Total restocking cost} &= \text{Fixed cost per order} \times \text{Number of orders} \\ &= F \times (T/Q)\end{aligned}$$

20.11

For Eyssell, order costs might be \$50 per order, so the total restocking cost for 13 orders would be $\$50 \times 13 = \650 per year.

The Total Costs The total costs associated with holding inventory are the sum of the carrying costs and the restocking costs:

$$\begin{aligned}\text{Total costs} &= \text{Carrying costs} + \text{Restocking costs} \\ &= (Q/2) \times CC + F \times (T/Q)\end{aligned}$$

20.12

Our goal is to find the value of Q , the restocking quantity, that minimizes this cost. To see how we might go about this, we can calculate total costs for some different values of Q . For the Eyssell Corporation, we had carrying costs (CC) of \$.75 per unit per year, fixed costs (F) of \$50 per order, and total unit sales (T) of 46,800 units. With these numbers, here are some possible total costs (check some of these for practice):

Restocking Quantity (Q)	Carrying Costs (Q/2 × CC)	+	Restocking Costs (F × T/Q)	=	Total Costs
500	\$ 187.5		\$4,680.0		\$4,867.5
1,000	375.0		2,340.0		2,715.0
1,500	562.5		1,560.0		2,122.5
2,000	750.0		1,170.0		1,920.0
2,500	937.5		936.0		1,873.5
3,000	1,125.0		780.0		1,905.0
3,500	1,312.5		668.6		1,981.1

Inspecting the numbers, we see that total costs start out at almost \$5,000 and decline to just under \$1,900. The cost-minimizing quantity is about 2,500.

To find the exact cost-minimizing quantity, we can look back at Figure 20.3. What we notice is that the minimum point occurs right where the two lines cross. At this point, carrying costs and restocking costs are the same. For the particular types of costs we have assumed here, this will always be true; so we can find the minimum point by setting these costs equal to each other and solving for Q^* :

$$\begin{aligned}\text{Carrying costs} &= \text{Restocking costs} \\ (Q^*/2) \times CC &= F \times (T/Q^*)\end{aligned}$$

20.13

With a little algebra, we get:

$$Q^{*2} = \frac{2T \times F}{CC}$$

To solve for Q^* , we take the square root of both sides to find:

$$Q^* = \sqrt{\frac{2T \times F}{CC}}$$

economic order quantity (EOQ)

The restocking quantity that minimizes the total inventory costs.

$$\begin{aligned} Q^* &= \sqrt{\frac{2T \times F}{CC}} \\ &= \sqrt{\frac{(2 \times 46,800) \times \$50}{\$75}} \\ &= \sqrt{6,240,000} \\ &= 2,498 \text{ units} \end{aligned}$$

For Eysell, the economic order quantity is 2,498 units. At this level, verify that the restocking costs and carrying costs are both \$936.75.

EXAMPLE 20.2

Carrying Costs

Thiewes Shoes begins each period with 100 pairs of hiking boots in stock. This stock is depleted each period and reordered. If the carrying cost per pair of boots per year is \$3, what are the total carrying costs for the hiking boots?

Inventories always start at 100 items and end up at zero, so average inventory is 50 items. At an annual cost of \$3 per item, total carrying costs are \$150.

EXAMPLE 20.3

Restocking Costs

In Example 20.2, suppose Thiewes sells a total of 600 pairs of boots in a year. How many times per year does Thiewes restock? Suppose the restocking cost is \$20 per order. What are total restocking costs?

Thiewes orders 100 items each time. Total sales are 600 items per year, so Thiewes restocks six times per year, or about once every two months. The restocking costs would be 6 orders \times \$20 per order = \$120.

EXAMPLE 20.4

The EOQ

Based on our previous two examples, what size orders should Thiewes place to minimize costs? How often will Thiewes restock? What are the total carrying and restocking costs? The total costs?

We know that the total number of pairs of boots ordered for the year (T) is 600. The restocking cost (F) is \$20 per order, and the carrying cost (CC) is \$3. We can calculate the EOQ for Thiewes as follows:

$$\begin{aligned} \text{EOQ} &= \sqrt{\frac{2T \times F}{CC}} \\ &= \sqrt{\frac{(2 \times 600) \times \$20}{\$3}} \\ &= \sqrt{8,000} \\ &= 89.44 \text{ units} \end{aligned}$$

Because Thiewes sells 600 pairs per year, it will restock $600/89.44 = 6.71$ times. The total restocking costs will be $\$20 \times 6.71 = \134.16 . Average inventory will be $89.44/2 = 44.72$. The carrying costs will be $\$3 \times 44.72 = \134.16 , the same as the restocking costs. The total costs are \$268.33.

EXTENSIONS TO THE EOQ MODEL

Thus far, we have assumed that a company will let its inventory run down to zero and then reorder. In reality, a company will wish to reorder before its inventory goes to zero for two reasons. First, by always having at least some inventory on hand, the firm minimizes the risk of a stockout and the resulting losses of sales and customers. Second, when a firm does reorder, there will be some time lag before the inventory arrives. To finish our discussion of the EOQ, we consider two extensions: Safety stocks and reordering points.

Safety Stocks A *safety stock* is the minimum level of inventory that a firm keeps on hand. Inventories are reordered whenever the level of inventory falls to the safety stock level. The top of Figure 20.5 (Part A) illustrates how a safety stock can be incorporated into an EOQ model. Notice that adding a safety stock means that the firm does not run its inventory all the way down to zero. Other than this, the situation here is identical to that described in our earlier discussion of the EOQ.

Reorder Points To allow for delivery time, a firm will place orders before inventories reach a critical level. The *reorder points* are the times at which the firm will actually place its inventory orders. These points are illustrated in the middle of Figure 20.5 (Part B). As shown, the reorder points occur some fixed number of days (or weeks or months) before inventories are projected to reach zero.

One of the reasons that a firm will keep a safety stock is to allow for uncertain delivery times. We can combine our reorder point and safety stock discussions in the bottom part of Figure 20.5 (Part C). The result is a generalized EOQ model in which the firm orders in advance of anticipated needs and also keeps a safety stock of inventory.

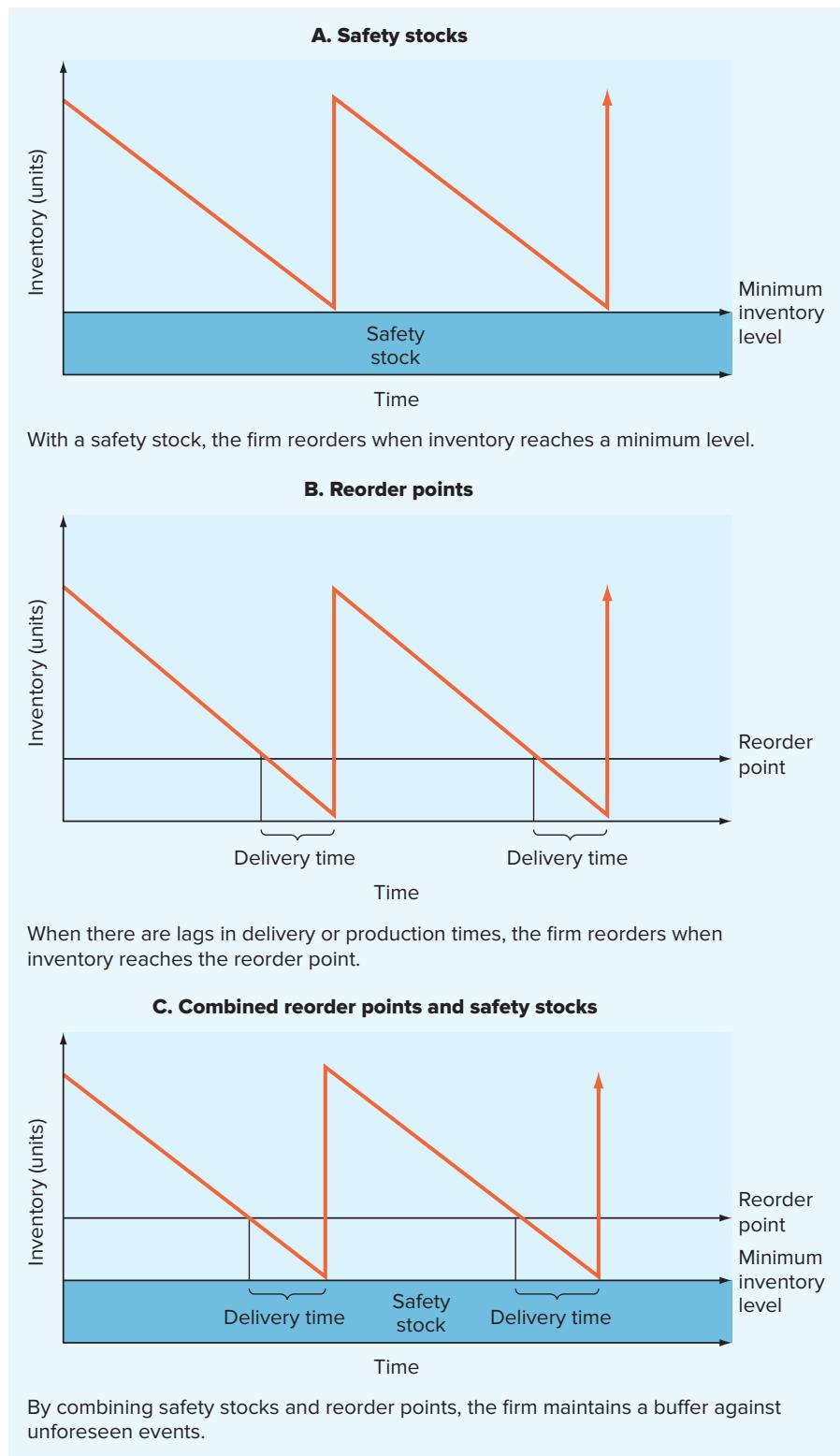
MANAGING DERIVED-DEMAND INVENTORIES

The third type of inventory management technique is used to manage derived-demand inventories. As we described earlier, demand for some inventory types is derived from or dependent on other inventory needs. A good example is the auto manufacturing industry, in which the demand for finished products depends on consumer demand, marketing programs, and other factors related to projected unit sales. The demand for inventory items such as tires, batteries, headlights, and other components is then completely determined by the number of autos planned. Materials requirements planning and just-in-time inventory management are two methods for managing demand-dependent inventories.

Materials Requirements Planning Production and inventory specialists have developed computer-based systems for ordering and/or scheduling production of demand-dependent types of inventories. These systems fall under the general heading of **materials requirements planning (MRP)**. The basic idea behind MRP is that, once finished goods inventory levels are set, it is possible to determine what levels of work-in-progress inventories must exist to meet the need for finished goods. From there, it is possible to calculate the quantity of raw materials that must be on hand. This ability to schedule backward from finished goods inventories stems from the dependent nature of work-in-progress and raw

materials requirements planning (MRP)

A set of procedures used to determine inventory levels for demand-dependent inventory types such as work-in-progress and raw materials.

FIGURE 20.5**Safety Stocks and Reorder Points**

materials inventories. MRP is particularly important for complicated products for which a variety of components are needed to create the finished product.

Just-in-Time Inventory **Just-in-time (JIT) inventory** is a modern approach to managing dependent inventories. The goal of JIT is to minimize such inventories, thereby maximizing turnover. The approach began in Japan, and it is a fundamental part of Japanese manufacturing philosophy. As the name suggests, the basic goal of JIT is to have only enough inventory on hand to meet immediate production needs.

The result of the JIT system is that inventories are reordered and restocked frequently. Making such a system work and avoiding shortages requires a high degree of cooperation among suppliers. Japanese manufacturers often have a relatively small, tightly integrated group of suppliers with whom they work closely to achieve the needed coordination. These suppliers are a part of a large manufacturer's (such as Toyota's) industrial group, or *keiretsu*. Each large manufacturer tends to have its own *keiretsu*. It also helps to have suppliers located nearby, a situation that is common in Japan.

The *kanban* is an integral part of a JIT inventory system, and JIT systems are sometimes called *kanban systems*. The literal meaning of *kanban* is “card” or “sign”; but, broadly speaking, a kanban is a signal to a supplier to send more inventory. A kanban can literally be a card attached to a bin of parts. When a worker pulls that bin, the card is detached and routed back to the supplier, who then supplies a replacement bin.

A JIT inventory system is an important part of a larger production planning process. A full discussion of it would necessarily shift our focus away from finance to production and operations management, so we will leave it here.

just-in-time (JIT) inventory

A system for managing demand-dependent inventories that minimizes inventory holdings.

Concept Questions

- 20.8a** What does the EOQ model determine for the firm?
- 20.8b** Which cost component of the EOQ model does the JIT inventory system minimize?

Summary and Conclusions

20.9

This chapter has covered the basics of credit and inventory policy. The major topics we discussed include these:

- 1. The components of credit policy:** We discussed the terms of sale, credit analysis, and collection policy. Under the general subject of terms of sale, the credit period, the cash discount and discount period, and the credit instrument were described.
- 2. Credit policy analysis:** We developed the cash flows from the decision to grant credit and showed how the credit decision can be analyzed in an NPV setting. The NPV of granting credit depends on five factors: Revenue effects, cost effects, the cost of debt, the probability of nonpayment, and the cash discount.
- 3. Optimal credit policy:** The optimal amount of credit the firm should offer depends on the competitive conditions under which the firm operates. These conditions will determine the carrying costs associated with granting credit and the opportunity costs of the lost sales resulting from the refusal to offer credit. The optimal credit policy minimizes the sum of these two costs.

4. *Credit analysis:* We looked at the decision to grant credit to a particular customer. We saw that two considerations are very important: The cost relative to the selling price and the possibility of repeat business.
5. *Collection policy:* Collection policy determines the method of monitoring the age of accounts receivable and dealing with past-due accounts. We described how an aging schedule can be prepared and the procedures a firm might use to collect on past-due accounts.
6. *Inventory types:* We described the different inventory types and how they differ in terms of liquidity and demand.
7. *Inventory costs:* The two basic inventory costs are carrying and restocking costs; we discussed how inventory management involves a trade-off between these two costs.
8. *Inventory management techniques:* We described the ABC approach and the EOQ model approach to inventory management. We also briefly touched on materials requirements planning (MRP) and just-in-time (JIT) inventory management.

CONNECT TO FINANCE



Connect Finance offers plenty of opportunities to practice mastering these concepts. Log on to connect.mheducation.com to learn more. If you like what you see, ask your professor about using *Connect Finance*!

Can you answer the following *Connect Quiz* questions?

- Section 20.1** What is the difference between the accounts receivable period and the cash collection period?
- Section 20.2** Marsha can purchase goods for her store on credit terms of 2/10, net 25. What is the effective annual rate that Marsha will pay if she forgoes the discount on a purchase of \$8,700?
- Section 20.7** If Rosie's Formal Attire has too low an inventory, the firm is most apt to _____.

CHAPTER REVIEW AND SELF-TEST PROBLEMS

- 20.1 Credit Policy** The Cold Fusion Corp. (manufacturer of the Mr. Fusion home power plant) is considering a new credit policy. The current policy is cash only. The new policy would involve extending credit for one period. Based on the following information, determine if a switch is advisable. The interest rate is 2 percent per period:

	Current Policy	New Policy
Price per unit	\$ 175	\$ 175
Cost per unit	\$ 130	\$ 130
Sales per period in units	1,000	1,100

- 20.2 Credit Where Credit Is Due** You are trying to decide whether or not to extend credit to a particular customer. Your variable cost is \$15 per unit; the selling price is \$22. This customer wants to buy 1,000 units today and pay in 30 days. You think there is a 15 percent chance of default. The required return is 3 percent per 30 days. Should you extend credit? Assume that this is a one-time sale and that the customer will not buy if credit is not extended.

- 20.3 The EOQ** Annondale Manufacturing starts each period with 10,000 “Long John” golf clubs in stock. This stock is depleted each month and reordered. If the carrying cost per golf club is \$1, and the fixed order cost is \$5, is Annondale following an economically advisable strategy?

ANSWERS TO CHAPTER REVIEW AND SELF-TEST PROBLEMS

- 20.1** If the switch is made, an extra 100 units per period will be sold at a gross profit of $\$175 - \$130 = \$45$ each. The total benefit is thus $\$45 \times 100 = \$4,500$ per period. At 2 percent per period forever, the PV is $\$4,500 / 0.02 = \$225,000$.

The cost of the switch is equal to this period’s revenue of $\$175 \times 1,000$ units = **\$175,000** plus the cost of producing the extra 100 units: $100 \times \$130 = \$13,000$. The total cost is thus **\$188,000**, and the NPV is $\$225,000 - 188,000 = \$37,000$. The switch should be made.

- 20.2** If the customer pays in 30 days, then you will collect $\$22 \times 1,000 = \$22,000$. There’s only an 85 percent chance of collecting this; so you expect to get $\$22,000 \times .85 = \$18,700$ in 30 days. The present value of this is $\$18,700 / 1.03 = \$18,155.34$. Your cost is $\$15 \times 1,000 = \$15,000$; so the NPV is $\$18,155.34 - 15,000 = \$3,155.34$. Credit should be extended.

- 20.3** We can answer by first calculating Annondale’s carrying and restocking costs. The average inventory is 5,000 clubs, and, because the carrying costs are \$1 per club, total carrying costs are **\$5,000**. Annondale restocks every month at a fixed order cost of \$5, so the total restocking costs are **\$60**. What we see is that carrying costs are large relative to reorder costs, so Annondale is carrying too much inventory.

To determine the optimal inventory policy, we can use the EOQ model. Because Annondale orders 10,000 golf clubs 12 times per year, total needs (T) are **120,000** golf clubs. The fixed order cost is \$5, and the carrying cost per unit (CC) is \$1. The EOQ is therefore:

$$\begin{aligned} \text{EOQ} &= \sqrt{\frac{2T \times F}{CC}} \\ &= \sqrt{\frac{(2 \times 120,000) \times \$5}{\$1}} \\ &= \sqrt{1,200,000} \\ &= \mathbf{1,095.45 \text{ units}} \end{aligned}$$

We can check this by noting that the average inventory is about 550 clubs, so the carrying cost is \$550. Annondale will have to reorder $120,000 / 1,095.45 = 109.54 \approx 110$ times. The fixed order cost is \$5, so the total restocking cost is also about **\$550**.

CONCEPTS REVIEW AND CRITICAL THINKING QUESTIONS

- Credit Instruments [LO1]** Describe each of the following:
 - Sight draft.
 - Time draft.
 - Banker’s acceptance.
 - Promissory note.
 - Trade acceptance.

2. **Trade Credit Forms [LO1]** In what form is trade credit most commonly offered? What is the credit instrument in this case?
3. **Receivables Costs [LO1]** What costs are associated with carrying receivables? What costs are associated with not granting credit? What do we call the sum of the costs for different levels of receivables?
4. **Five Cs of Credit [LO1]** What are the five Cs of credit? Explain why each is important.
5. **Credit Period Length [LO1]** What are some of the factors that determine the length of the credit period? Why is the length of the buyer's operating cycle often considered an upper bound on the length of the credit period?
6. **Credit Period Length [LO1]** In each of the following pairings, indicate which firm would probably have a longer credit period and explain your reasoning.
 - a. Firm A sells a miracle cure for baldness; Firm B sells toupees.
 - b. Firm A specializes in products for landlords; Firm B specializes in products for renters.
 - c. Firm A sells to customers with an inventory turnover of 10 times; Firm B sells to customers with an inventory turnover of 20 times.
 - d. Firm A sells fresh fruit; Firm B sells canned fruit.
 - e. Firm A sells and installs carpeting; Firm B sells rugs.
7. **Inventory Types [LO3]** What are the different inventory types? How do the types differ? Why are some types said to have dependent demand whereas other types are said to have independent demand?
8. **Just-in-Time Inventory [LO3]** If a company moves to a JIT inventory management system, what will happen to inventory turnover? What will happen to total asset turnover? What will happen to return on equity (ROE)? *Hint:* Remember the DuPont equation from Chapter 3.
9. **Inventory Costs [LO3]** If a company's inventory carrying costs are \$5 million per year and its fixed order costs are \$8 million per year, do you think the firm keeps too much inventory on hand or too little? Why?
10. **Inventory Period [LO3]** At least part of Dell's corporate profits can be traced to its inventory management. Using just-in-time inventory, Dell typically maintains an inventory of three to four days' sales. Competitors such as Hewlett-Packard and IBM have attempted to match Dell's inventory policies, but they lag far behind. In an industry where the price of PC components continues to decline, Dell clearly has a competitive advantage. Why would you say that it is to Dell's advantage to have such a short inventory period? If doing this is valuable, why don't all other PC manufacturers switch to Dell's approach?

QUESTIONS AND PROBLEMS



1. **Cash Discounts [LO1]** You place an order for 300 units of inventory at a unit price of \$140. The supplier offers terms of 1/10, net 30.
 - a. How long do you have to pay before the account is overdue? If you take the full period, how much should you remit?
 - b. What is the discount being offered? How quickly must you pay to get the discount? If you do take the discount, how much should you remit?

- c. If you don't take the discount, how much interest are you paying implicitly? How many days' credit are you receiving?
2. **Size of Accounts Receivable [LO1]** The Red Zeppelin Corporation has annual sales of \$34 million. The average collection period is 28 days. What is the average investment in accounts receivable as shown on the balance sheet? Assume 365 days per year.
3. **ACP and Accounts Receivable [LO1]** Kyoto Joe, Inc., sells earnings forecasts for Japanese securities. Its credit terms are 2/10, net 30. Based on experience, 70 percent of all customers will take the discount.
- a. What is the average collection period for the company?
 - b. If the company sells 1,120 forecasts every month at a price of \$1,580 each, what is its average balance sheet amount in accounts receivable?
4. **Size of Accounts Receivable [LO1]** Skye Flyer, Inc., has weekly credit sales of \$21,900, and the average collection period is 33 days. What is the average accounts receivable figure?
5. **Terms of Sale [LO1]** A firm offers terms of 1/10, net 30. What effective annual interest rate does the firm earn when a customer does not take the discount? Without doing any calculations, explain what will happen to this effective rate if:
- a. The discount is changed to 2 percent.
 - b. The credit period is increased to 45 days.
 - c. The discount period is increased to 14 days.
6. **ACP and Receivables Turnover [LO1]** Starset, Inc., has an average collection period of 27 days. Its average daily investment in receivables is \$46,300. What are annual credit sales? What is the receivables turnover? Assume 365 days per year.
7. **Size of Accounts Receivable [LO1]** Essence of Skunk Fragrances, Ltd., sells 7,900 units of its perfume collection each year at a price per unit of \$385. All sales are on credit with terms of 1/10, net 40. The discount is taken by 65 percent of the customers. What is the amount of the company's accounts receivable? In reaction to sales by its main competitor, Sewage Spray, Essence of Skunk is considering a change in its credit policy to terms of 2/10, net 30 to preserve its market share. How will this change in policy affect accounts receivable?
8. **Size of Accounts Receivable [LO1]** The Arizona Bay Corporation sells on credit terms of net 30. Its accounts are, on average, five days past due. If annual credit sales are \$8.35 million, what is the company's balance sheet amount in accounts receivable?
9. **Evaluating Credit Policy [LO2]** Air Spares is a wholesaler that stocks engine components and test equipment for the commercial aircraft industry. A new customer has placed an order for eight high-bypass turbine engines, which increase fuel economy. The variable cost is \$1.25 million per unit, and the credit price is \$1.63 million each. Credit is extended for one period, and based on historical experience, payment for about 1 out of every 200 such orders is never collected. The required return is 1.8 percent per period.
- a. Assuming that this is a one-time order, should it be filled? The customer will not buy if credit is not extended.
 - b. What is the break-even probability of default in part (a)?
 - c. Suppose that customers who don't default become repeat customers and place the same order every period forever. Further assume that repeat customers never default. Should the order be filled? What is the break-even probability of default?
 - d. Describe in general terms why credit terms will be more liberal when repeat orders are a possibility.

- 10. Credit Policy Evaluation [LO2]** Sanchez, Inc., is considering a change in its cash-only sales policy. The new terms of sale would be net one month. Based on the following information, determine if the company should proceed or not. Describe the buildup of receivables in this case. The required return is .95 percent per month.

	Current Policy	New Policy
Price per unit	\$ 540	\$ 540
Cost per unit	\$ 395	\$ 395
Unit sales per month	1,080	1,130

- 11. EOQ [LO4]** Provenza Manufacturing uses 3,400 switch assemblies per week and then reorders another 3,400. If the relevant carrying cost per switch assembly is \$7.45, and the fixed order cost is \$1,100, is the company's inventory policy optimal? Why or why not?
- 12. EOQ [LO4]** The Trektronics store begins each week with 450 phasers in stock. This stock is depleted each week and reordered. If the carrying cost per phaser is \$34 per year and the fixed order cost is \$130, what is the total carrying cost? What is the restocking cost? Should the company increase or decrease its order size? Describe an optimal inventory policy for the company in terms of order size and order frequency.
- 13. EOQ Derivation [LO4]** Prove that when carrying costs and restocking costs are as described in the chapter, the EOQ must occur at the point where the carrying costs and restocking costs are equal.
- 14. Credit Policy Evaluation [LO2]** The Sneedeler Corporation is considering a change in its cash-only policy. The new terms would be net one period. Based on the following information, determine if the company should proceed or not. The required return is 2.3 percent per period.

	Current Policy	New Policy
Price per unit	\$ 81	\$ 84
Cost per unit	\$ 47	\$ 47
Unit sales per month	3,280	3,390

- 15. Credit Policy Evaluation [LO2]** Veni, Inc., currently has an all-cash credit policy. It is considering making a change in the credit policy by going to terms of net 30 days. Based on the following information, what do you recommend? The required return is .85 percent per month.

	Current Policy	New Policy
Price per unit	\$ 131	\$ 133
Cost per unit	\$ 96	\$ 98
Unit sales per month	1,320	1,340

- 16. Credit Policy [LO2]** The Silver Spokes Bicycle Shop has decided to offer credit to its customers during the spring selling season. Sales are expected to be 125 bicycles. The average cost to the shop of a bicycle is \$750. The owner knows that only 96 percent of the customers will be able to make their payments. To identify the remaining 4 percent, the company is considering subscribing to a credit agency. The initial charge for this service is \$1,000, with an additional charge of \$8.95 per individual report. Should she subscribe to the agency?
- 17. Break-Even Quantity [LO2]** In Problem 14, what is the break-even quantity for the new credit policy?

18. **Credit Markup [LO2]** In Problem 14, what is the break-even price per unit that should be charged under the new credit policy? Assume that the sales figure under the new policy is 3,310 units and all other values remain the same.
19. **Credit Markup [LO2]** In Problem 15, what is the break-even price per unit under the new credit policy? Assume all other values remain the same.
20. **Safety Stocks and Order Points [LO4]** Saché, Inc., expects to sell 700 of its designer suits every week. The store is open seven days a week and expects to sell the same number of suits every day. The company has an EOQ of 500 suits and a safety stock of 100 suits. Once an order is placed, it takes three days for Saché to get the suits in. How many orders does the company place per year? Assume that it is Monday morning before the store opens, and a shipment of suits has just arrived. When will Saché place its next order?
21. **Evaluating Credit Policy [LO2]** Solar Engines manufactures solar engines for tractor-trailers. Given the fuel savings available, new orders for 125 units have been made by customers requesting credit. The variable cost is \$6,900 per unit, and the credit price is \$7,600 each. Credit is extended for one period. The required return is 1.9 percent per period. If Solar Engines extends credit, it expects that 30 percent of the customers will be repeat customers and place the same order every period forever and the remaining customers will be one-time orders. Should credit be extended?
22. **Evaluating Credit Policy [LO2]** In Problem 21, assume that the probability of default is 15 percent. Should the orders be filled now? Assume the number of repeat customers is affected by the defaults. In other words, 30 percent of the customers who do not default are expected to be repeat customers.

MINICASE

Credit Policy at Howlett Industries

Sterling Wyatt, the president of Howlett Industries, has been exploring ways of improving the company's financial performance. Howlett manufactures and sells office equipment to retailers. The company's growth has been relatively slow in recent years, but with an expansion in the economy, it appears that sales may increase more rapidly in the future. Sterling has asked Evan Bradds, the company's treasurer, to examine Howlett's credit policy to see if a change can help increase profitability.

The company currently has a policy of net 30. As with any credit sales, default rates are always of concern. Because of Howlett's screening and collection process, the default rate on credit is currently only 1.6 percent. Evan has examined the company's credit policy in relation to other vendors, and he has found three available options.

The first option is to relax the company's decision on when to grant credit. The second option is to increase the credit period to net 45, and the third option is a combination of the relaxed credit policy and the extension of the credit period to net 45. On the positive side, each of the three policies under consideration would increase sales. The three policies have the drawbacks that default rates would increase, the administrative costs of managing the firm's receivables would increase, and the receivables period would increase. The effect of the credit policy change would impact all four of these variables to different degrees. Evan has prepared the following table outlining the effect on each of these variables:

	Annual Sales (millions)	Default Rate (% of sales)	Administrative Costs (% of sales)	Receivables Period
Current Policy	\$134	1.6%	2.2%	37 days
Option 1	158	2.5	3.2	40 days
Option 2	155	1.8	2.4	50 days
Option 3	170	2.2	3.0	48 days

Howlett's variable costs of production are 45 percent of sales, and the relevant interest rate is a 6 percent effective annual rate.

QUESTIONS

1. Which credit policy should the company use?
2. Notice that in Option 3, the default rate and the administrative costs both exceed those in Option 2. Is this plausible? Why or why not?

20.A More about Credit Policy Analysis

This appendix takes a closer look at credit policy analysis by investigating some alternative approaches and by examining the effect of cash discounts and the possibility of nonpayment.

TWO ALTERNATIVE APPROACHES

From our chapter discussion, we know how to analyze the NPV of a proposed credit policy switch. We now discuss two alternative approaches: The one-shot approach and the accounts receivable approach. These are common means of analysis; our goal is to show that these two approaches and our NPV approach are all the same. Afterward, we will use whichever of the three is most convenient.

The One-Shot Approach Looking back at our example for Locust Software (in Section 20.3), we see that if the switch is not made, Locust will have a net cash flow this month of $(P - v)Q = \$29 \times 100 = \$2,900$. If the switch is made, Locust will invest $vQ' = \$20 \times 110 = \$2,200$ this month and will receive $PQ' = \$49 \times 110 = \$5,390$ next month. Suppose we ignore all other months and cash flows and view this as a one-shot investment. Is Locust better off with \$2,900 in cash this month, or should Locust invest the \$2,200 to get \$5,390 next month?

The present value of the \$5,390 to be received next month is $\$5,390/1.02 = \$5,284.31$; the cost is \$2,200, so the net benefit is $\$5,284.31 - 2,200 = \$3,084.31$. If we compare this to the net cash flow of \$2,900 under the current policy, then we see that Locust should switch. The NPV is $\$3,084.31 - 2,900 = \184.31 .

In effect, Locust can repeat this one-shot investment every month and thereby generate an NPV of \$184.31 every month (including the current one). The PV of this series of NPVs is:

$$\text{Present value} = \$184.31 + \$184.31/1.02 = \$9,400$$

This PV is the same as our answer in Section 20.3.

The Accounts Receivable Approach Our second approach is the one that is most commonly discussed and is very useful. By extending credit, the firm increases its cash flow through increased gross profits. The firm must increase its investment in receivables and bear the carrying cost of doing so. The accounts receivable approach focuses on the expense of the incremental investment in receivables as compared to the increased gross profit.

As we have seen, the monthly benefit from extending credit is given by the gross profit per unit ($P - v$) multiplied by the increase in quantity sold ($Q' - Q$). For Locust, this benefit is $(\$49 - 20) \times (110 - 100) = \290 per month.

If Locust makes the switch, then receivables will rise from zero (because there are currently no credit sales) to PQ' , so Locust must invest in receivables. The necessary investment has two components. The first part is what Locust would have collected under the old

policy (PQ). Locust must carry this amount in receivables each month because collections are delayed by 30 days.

The second part is related to the increase in receivables that results from the increase in sales. Because unit sales increase from Q to Q' , Locust must produce the latter quantity today even though it won't collect payment for 30 days. The actual cost to Locust of producing the extra quantity is equal to v per unit, so the investment necessary to provide the extra quantity sold is $v(Q' - Q)$.

In sum, if Locust switches, its investment in receivables will be equal to the $P \times Q$ in revenues plus an additional $v(Q' - Q)$ in production costs:

$$\text{Incremental investment in receivables} = PQ + v(Q' - Q)$$

The required return on this investment (the carrying cost of the receivables) is R per month; so, for Locust, the accounts receivable carrying cost is:

$$\begin{aligned}\text{Carrying cost} &= [PQ + v(Q' - Q)] \times R \\ &= (\$4,900 + 200) \times .02 \\ &= \$102 \text{ per month}\end{aligned}$$

Because the monthly benefit is \$290 and the cost per month is only \$102, the net benefit is $\$290 - 102 = \188 per month. Locust earns this \$188 every month, so the PV of the switch is:

$$\begin{aligned}\text{Present value} &= \$188/.02 \\ &= \$9,400\end{aligned}$$

Again, this is the same figure we previously calculated.

One of the advantages of looking at the accounts receivable approach is that it helps us interpret our earlier NPV calculation. As we have seen, the investment in receivables necessary to make the switch is $PQ + v(Q' - Q)$. If you take a look back at our original NPV calculation, you'll see that this is precisely what we had as the cost to Locust of making the switch. Our earlier NPV calculation amounts to a comparison of the incremental investment in receivables to the PV of the increased future cash flows.

Notice one final thing. The increase in accounts receivable is PQ' , and this amount corresponds to the amount of receivables shown on the balance sheet. The incremental investment in receivables is $PQ + v(Q' - Q)$. It is straightforward to verify that this second quantity is smaller by $(P - v)(Q' - Q)$. This difference is the gross profit on the new sales, which Locust does not actually have to put up in order to switch credit policies.

Put another way, whenever we extend credit to a new customer who would not otherwise buy, all we risk is our cost, not the full sales price. This is the same issue that we discussed in Section 20.5.

Extra Credit

EXAMPLE 20A.1

Looking back at Locust Software, determine the NPV of the switch if the quantity sold is projected to increase by only 5 units instead of 10. What will be the investment in receivables? What is the carrying cost? What is the monthly net benefit from switching?

If the switch is made, Locust gives up $P \times Q = \$4,900$ today. An extra five units have to be produced at a cost of \$20 each, so the cost of switching is $\$4,900 + 5 \times \$20 = \$5,000$. The benefit each month of selling the extra five units is $5 \times (\$49 - 20) = \145 . The NPV of the switch is $-\$5,000 + \$145/.02 = \$2,250$, so the switch is still profitable.

The \$5,000 cost of switching can be interpreted as the investment in receivables. At 2 percent per month, the carrying cost is $.02 \times \$5,000 = \100 . Because the benefit each month is \$145, the net benefit from switching is \$45 per month ($= \$145 - 100$). Notice that the PV of \$45 per month forever at 2 percent is $\$45/.02 = \$2,250$, as we calculated above.

DISCOUNTS AND DEFAULT RISK

We now take a look at cash discounts, default risk, and the relationship between the two. To get started, we define the following:

π = Percentage of credit sales that go uncollected

d = Percentage discount allowed for cash customers

P' = Credit price (the no-discount price)

Notice that the cash price, P , is equal to the credit price, P' , multiplied by $(1 - d)$: $P = P'(1 - d)$, or, equivalently, $P' = P/(1 - d)$.

The situation at Locust is now a little more complicated. If a switch is made from the current policy of no credit, then the benefit from the switch will come from both the higher price (P') and, potentially, the increased quantity sold (Q').

Furthermore, in our previous case, it was reasonable to assume that all customers took the credit because it was free. Now, not all customers will take the credit because a discount is offered. In addition, of the customers who do take the credit offered, a certain percentage (π) will not pay.

To simplify the discussion that follows, we will assume that the quantity sold (Q) is unaffected by the switch. This assumption isn't crucial, but it does cut down on the work (see Problem 5 at the end of the appendix). We will also assume that all customers take the credit terms. This assumption isn't crucial either. It actually doesn't matter what percentage of the customers take the offered credit.³

NPV of the Credit Decision Currently, Locust sells Q units at a price of $P = \$49$. Locust is considering a new policy that involves 30 days' credit and an increase in price to $P' = \$50$ on credit sales. The cash price will remain at \$49, so Locust is effectively allowing a discount of $(\$50 - 49)/\$50 = .02$, or 2% for cash.

What is the NPV to Locust of extending credit? To answer, note that Locust is already receiving $(P - v)Q$ every month. With the new higher price, this will rise to $(P' - v)Q$, assuming that everybody pays. Because π percent of sales will not be collected, Locust will collect on only $(1 - \pi) \times P'Q$; so net receipts will be $[(1 - \pi)P' - v] \times Q$.

The net effect of the switch for Locust is the difference between the cash flows under the new policy and those under the old policy:

$$\text{Net incremental cash flow} = [(1 - \pi)P' - v] \times Q - (P - v) \times Q$$

Because $P = P' \times (1 - d)$, this simplifies to:⁴

$$\text{Net incremental cash flow} = P'Q \times (d - \pi)$$

20A.1

³The reason is that all customers are offered the same terms. If the NPV of offering credit is \$100, assuming that all customers switch, then it will be \$50 if only 50 percent of our customers switch. The hidden assumption is that the default rate is a constant percentage of credit sales.

⁴To see this, note that the net incremental cash flow is:

$$\begin{aligned}\text{Net incremental cash flow} &= [(1 - \pi)P' - v] \times Q - (P - v) \times Q \\ &= [(1 - \pi)P' - P] \times Q\end{aligned}$$

Because $P = P' \times (1 - d)$, this can be written as:

$$\begin{aligned}\text{Net incremental cash flow} &= [(1 - \pi)P' - (1 - d)P'] \times Q \\ &= P'Q \times (d - \pi)\end{aligned}$$

If Locust makes the switch, the cost in terms of the investment in receivables is $P \times Q$ because $Q = Q'$. The NPV of the switch is:

$$\text{NPV} = -PQ + P'Q \times (d - \pi)/R$$

20A.2

Suppose that, based on industry experience, the percentage of “deadbeats” (π) is expected to be 1 percent. What is the NPV of changing credit terms for Locust? We can plug in the relevant numbers as follows:

$$\begin{aligned}\text{NPV} &= -PQ + P'Q \times (d - \pi)/R \\ &= -\$49 \times 100 + \$50 \times 100 \times (.02 - .01)/.02 \\ &= -\$2,400\end{aligned}$$

Because the NPV of the change is negative, Locust shouldn’t switch.

In our expression for NPV, the key elements are the cash discount percentage (d) and the default rate (π). One thing we see immediately is that, if the percentage of sales that goes uncollected exceeds the discount percentage, then $d - \pi$ is negative. Obviously, the NPV of the switch would then be negative as well. More generally, our result tells us that the decision to grant credit here is a trade-off between getting a higher price, thereby increasing sales revenues, and not collecting on some fraction of those sales.

With this in mind, note that $P'Q \times (d - \pi)$ is the increase in sales less the portion of that increase that won’t be collected. This is the incremental cash inflow from the switch in credit policy. If d is 5 percent and π is 2 percent, then, loosely speaking, revenues are increasing by 5 percent because of the higher price, but collections rise by only 3 percent because the default rate is 2 percent. Unless $d > \pi$, we will actually have a decrease in cash inflows from the switch.

A Break-Even Application Because the discount percentage (d) is controlled by the firm, the key unknown in this case is the default rate (π). What is the break-even default rate for Locust Software?

We can answer by finding the default rate that makes the NPV equal to zero:

$$\text{NPV} = 0 = -PQ + P'Q \times (d - \pi)/R$$

Rearranging things a bit, we have:

$$PR = P'(d - \pi)$$

$$\pi = d - R \times (1 - d)$$

For Locust, the break-even default rate works out to be:

$$\begin{aligned}\pi &= .02 - .02 \times (.98) \\ &= .0004, \text{ or } .04\%\end{aligned}$$

This is quite small because the implicit interest rate Locust will be charging its credit customers (2 percent discount interest per month, or about $.02/.98 = .020408$, or 2.0408%) is only slightly greater than the required return of 2 percent per month. As a result, there’s not much room for defaults if the switch is going to make sense.

Concept Questions

20A.1a What is the incremental investment that a firm must make in receivables if credit is extended?

20A.1b Describe the trade-off between the default rate and the cash discount.

APPENDIX REVIEW AND SELF-TEST PROBLEMS

- 20A.1 Credit Policy** Rework Chapter Review and Self-Test Problem 20.1 using the one-shot and accounts receivable approaches. As before, the required return is 2 percent per period, and there will be no defaults. Here is the basic information:

	Current Policy	New Policy
Price per unit	\$ 175	\$ 175
Cost per unit	\$ 130	\$ 130
Sales per period in units	1,000	1,100

- 20A.2 Discounts and Default Risk** The De Long Corporation is considering a change in credit policy. The current policy is cash only, and sales per period are 2,000 units at a price of \$110. If credit is offered, the new price will be \$120 per unit, and the credit will be extended for one period. Unit sales are not expected to change, and all customers are expected to take the credit. De Long anticipates that 4 percent of its customers will default. If the required return is 2 percent per period, is the change a good idea? What if only half the customers take the offered credit?

ANSWERS TO APPENDIX REVIEW AND SELF-TEST PROBLEMS

- 20A.1** As we saw earlier, if the switch is made, an extra 100 units per period will be sold at a gross profit of $\$175 - \$130 = \$45$ each. The total benefit is thus $\$45 \times 100 = \$4,500$ per period. At 2 percent per period forever, the PV is $\$4,500 / .02 = \$225,000$.

The cost of the switch is equal to this period's revenue of $\$175 \times 1,000$ units = **\$175,000** plus the cost of producing the extra 100 units, $100 \times \$130 = \$13,000$. The total cost is thus **\$188,000**, and the NPV is $\$225,000 - 188,000 = \$37,000$. The switch should be made.

For the accounts receivable approach, we interpret the \$188,000 cost as the investment in receivables. At 2 percent per period, the carrying cost is $\$188,000 \times .02 = \$3,760$ per period. The benefit per period we calculated as **\$4,500**; so the net gain per period is $\$4,500 - 3,760 = \740 . At 2 percent per period, the PV of this is $\$740 / .02 = \$37,000$.

Finally, for the one-shot approach, if credit is not granted, the firm will generate $(\$175 - \$130) \times 1,000 = \$45,000$ this period. If credit is extended, the firm will invest $\$130 \times 1,100 = \$143,000$ today and receive $\$175 \times 1,100 = \$192,500$ in one period. The NPV of this second option is $\$192,500 / 1.02 - \$143,000 = \$45,725.49$. The firm is $\$45,725.49 - 45,000 = \725.49 better off today and in each future period because of granting credit. The PV of this stream is $\$725.49 + \$725.49 / 1.02 = \$37,000$ (allowing for a rounding error).

- 20A.2** The costs per period are the same whether or not credit is offered; so we can ignore the production costs. The firm currently has sales of, and collects, $\$110 \times 2,000 = \$220,000$ per period. If credit is offered, sales will rise to $\$120 \times 2,000 = \$240,000$.

Defaults will be 4 percent of sales, so the cash inflow under the new policy will be $.96 \times \$240,000 = \$230,400$. This amounts to an extra **\$10,400** every period.

At 2 percent per period, the PV is $\$10,400/0.02 = \$520,000$. If the switch is made, De Long will give up this month's revenues of \$220,000; so the NPV of the switch is **\$300,000**. If only half of the customers take the credit, then the NPV is half as large: **\$150,000**. So, regardless of what percentage of customers take the credit, the NPV is positive. Thus, the change is a good idea.

QUESTIONS AND PROBLEMS

- Evaluating Credit Policy [LO2]** Bismark Co. is in the process of considering a change in its terms of sale. The current policy is cash only; the new policy will involve one period's credit. Sales are 25,000 units per period at a price of \$350 per unit. If credit is offered, the new price will be \$368. Unit sales are not expected to change, and all customers are expected to take the credit. Bismark estimates that 3 percent of credit sales will be uncollectible. If the required return is 2.5 percent per period, is the change a good idea?
- Credit Policy Evaluation [LO2]** The Johnson Company sells 2,400 pairs of running shoes per month at a cash price of \$99 per pair. The firm is considering a new policy that involves 30 days' credit and an increase in price to \$100 per pair on credit sales. The cash price will remain at \$99, and the new policy is not expected to affect the quantity sold. The discount period will be 20 days. The required return is .75 percent per month.
 - How would the new credit terms be quoted?
 - What investment in receivables is required under the new policy?
 - Explain why the variable cost of manufacturing the shoes is not relevant here.
 - If the default rate is anticipated to be 8 percent, should the switch be made? What is the break-even credit price? The break-even cash discount?
- Credit Analysis [LO2]** Silicon Wafers, Inc. (SWI), is debating whether or not to extend credit to a particular customer. SWI's products, primarily used in the manufacture of semiconductors, currently sell for \$975 per unit. The variable cost is \$540 per unit. The order under consideration is for 15 units today; payment is promised in 30 days.
 - If there is a 20 percent chance of default, should SWI fill the order? The required return is 2 percent per month. This is a one-time sale, and the customer will not buy if credit is not extended.
 - What is the break-even probability in part (a)?
 - This part is a little harder. In general terms, how do you think your answer to part (a) will be affected if the customer will purchase the merchandise for cash if the credit is refused? The cash price is \$910 per unit.
- Credit Analysis [LO2]** Consider the following information about two alternative credit strategies:



BASIC

(Questions 1–5)

	Refuse Credit	Grant Credit
Price per unit	\$ 64	\$ 69
Cost per unit	\$ 32	\$ 33
Quantity sold per quarter	5,800	6,400
Probability of payment	1.0	.90

The higher cost per unit reflects the expense associated with credit orders, and the higher price per unit reflects the existence of a cash discount. The credit period will be 90 days, and the cost of debt is .75 percent per month.

- a. Based on this information, should credit be granted?
 - b. In part (a), what does the credit price per unit have to be to break even?
 - c. In part (a), suppose we can obtain a credit report for \$1.50 per customer. Assuming that each customer buys one unit and that the credit report correctly identifies all customers who will not pay, should credit be extended?
5. **NPV of Credit Policy Switch [LO2]** Suppose a corporation currently sells Q units per month for a cash-only price of P . Under a new credit policy that allows one month's credit, the quantity sold will be Q' and the price per unit will be P' . Defaults will be π percent of credit sales. The variable cost is v per unit and is not expected to change. The percentage of customers who will take the credit is α , and the required return is R per month. What is the NPV of the decision to switch? Interpret the various parts of your answer.

International Corporate Finance

21

Chapter

IN 2018, CASH BALANCES held overseas by companies based in the United States were in the news. Apple led the way with over \$250 billion, followed by such companies as Microsoft (\$130 billion), and Google-parent Alphabet (\$94 billion). Before 2018, companies like Apple had a strong tax incentive to keep huge cash hoards outside the U.S. All of that changed with the signing of the Tax Cuts and Jobs Act of 2017, which ushered in big changes in the way U.S. corporations are taxed on their overseas operations. In this chapter, we discuss this topic, along with the important roles played by currencies, exchange rates, and other features of the international finance landscape.

Learning Objectives

After studying this chapter, you should be able to:

- L01** Define how exchange rates are quoted, what they mean, and the difference between spot and forward exchange rates.
- L02** Explain purchasing power parity, interest rate parity, unbiased forward rates, uncovered interest rate parity, and the international Fisher effect and their implications for exchange rate changes.
- L03** Illustrate the different types of exchange rate risk and ways firms manage exchange rate risk.
- L04** Show the impact of political risk on international business investing.

©by_adri/StockPhotoGettyimages

For updates on the latest happenings in finance, visit fundamentalsofcorporatefinance.blogspot.com.

Corporations with significant foreign operations are often called *international corporations* or *multinationals*. Such corporations must consider many financial factors that do not directly affect purely domestic firms. These include foreign exchange rates, differing interest rates from country to country, complex accounting methods for foreign operations, foreign tax rates, and foreign government intervention.

The basic principles of corporate finance still apply to international corporations; like domestic companies, these firms seek to invest in projects that create more value for the shareholders than they cost and to arrange financing that raises cash at the lowest possible cost. In other words, the net present value principle holds for both foreign and domestic operations, although it is usually more complicated to apply the NPV rule to foreign investments.

One of the most significant complications of international finance is foreign exchange. The foreign exchange markets provide important information and opportunities for an international corporation when it undertakes capital budgeting and financing decisions. As we will discuss, international exchange rates, interest rates, and inflation rates are closely related. We will spend much of this chapter exploring the connection between these financial variables.

We won't have much to say here about the role of cultural and social differences in international business. Neither will we be discussing the implications of differing political and economic systems. These factors are of great importance to international businesses, but it would take another book to do them justice. Consequently, we will focus only on some purely financial considerations in international finance and some key aspects of foreign exchange markets.

21.1 Terminology



See www.adr.com for more.

American Depository Receipt (ADR)

A security issued in the United States representing shares of a foreign stock and allowing that stock to be traded in the United States.

cross-rate

The implicit exchange rate between two currencies (usually non-U.S.) quoted in some third currency (usually the U.S. dollar).

Eurobonds

International bonds issued in multiple countries but denominated in a single currency (usually the issuer's currency).

Eurocurrency

Money deposited in a financial center outside of the country whose currency is involved.

foreign bonds

International bonds issued in a single country, usually denominated in that country's currency.

gilts

British and Irish government securities.

A common buzzword for the student of business finance is *globalization*. The first step in learning about the globalization of financial markets is to conquer the new vocabulary. As with any specialty, international finance is rich in jargon. Accordingly, we get started on the subject with a highly eclectic vocabulary exercise.

The terms that follow are presented alphabetically, and they are not all of equal importance. We choose these particular ones because they appear frequently in the financial press or because they illustrate the colorful nature of the language of international finance.

1. An **American Depository Receipt (ADR)** is a security issued in the United States that represents shares of a foreign stock, allowing that stock to be traded in the United States. Foreign companies use ADRs, which are issued in U.S. dollars, to expand the pool of potential U.S. investors. ADRs are available in two forms for a large and growing number of foreign companies: Company sponsored, which are listed on an exchange, and unsponsored, which usually are held by the investment bank that makes a market in the ADR. Both forms are available to individual investors, but only company-sponsored issues are quoted daily in newspapers.
2. The **cross-rate** is the implicit exchange rate between two currencies (usually non-U.S.) when both are quoted in some third currency, usually the U.S. dollar.
3. A **Eurobond** is a bond issued in multiple countries, but denominated in a single currency, usually the issuer's home currency. Such bonds have become an important way to raise capital for many international companies and governments. Eurobonds are issued outside the restrictions that apply to domestic offerings and are syndicated and traded mostly from London. However, trading takes place anywhere there is a buyer and a seller.
4. **Eurocurrency** is money deposited in a financial center outside of the country whose currency is involved. For instance, Eurodollars—the most widely used Eurocurrency—are U.S. dollars deposited in banks outside the U.S. banking system.
5. **Foreign bonds**, unlike Eurobonds, are issued in a single country and are usually denominated in that country's currency. Often, the country in which these bonds are issued will draw distinctions between them and bonds issued by domestic issuers, including different tax laws, restrictions on the amount issued, and tougher disclosure rules.
6. Foreign bonds often are nicknamed for the country where they are issued: Yankee bonds (United States), Samurai bonds (Japan), Rembrandt bonds (the Netherlands), Bulldog bonds (Britain), and dim sum bonds (Chinese yuan-denominated bonds issued in Hong Kong). Partly because of tougher regulations and disclosure requirements, the foreign bond market hasn't grown in past years with the vigor of the Eurobond market.
6. **Gilts**, technically, are British and Irish government securities, although the term also includes issues of local British authorities and some overseas public sector offerings.

7. The **London Interbank Offered Rate (LIBOR)** is the rate that most international banks charge one another for loans of Eurodollars overnight in the London market. LIBOR is a cornerstone in the pricing of money market issues and other short-term debt issues by both government and corporate borrowers. Interest rates are frequently quoted as some spread over LIBOR, and they then float with the LIBOR rate.
8. There are two basic kinds of **swaps**: Interest rate and currency. An interest rate swap occurs when two parties exchange a floating-rate payment for a fixed-rate payment, or vice versa. Currency swaps are agreements to deliver one currency in exchange for another. Often, both types of swaps are used in the same transaction when debt denominated in different currencies is swapped.

Concept Questions

- 21.1a** What are the differences between a Eurobond and a foreign bond?
21.1b What are Eurodollars?

London Interbank Offered Rate (LIBOR)

The rate most international banks charge one another for overnight Eurodollar loans.

swaps

Agreements to exchange two securities or currencies.



For current LIBOR rates, see www.bloomberg.com.

Foreign Exchange Markets and Exchange Rates

The **foreign exchange market** (also called the forex or FX market) is undoubtedly the world's largest financial market. It is the market where one country's currency is traded for another country's currency. Most of the trading takes place in a few currencies: The U.S. dollar (\$), the British pound sterling (£), the Japanese yen (¥), and the euro (€). Table 21.1 lists some of the more common currencies and their symbols.

Country	Currency	Symbol
Australia	Dollar	A\$
Canada	Dollar	Can\$
China	Yuan (Renminbi)	元
Denmark	Krone	DKr
EMU (Eurozone)	Euro	€
India	Rupee	Rs
Iran	Rial	RI
Japan	Yen	¥
Kuwait	Dinar	KD
Mexico	Peso	Ps
Norway	Krone	NKr
Saudi Arabia	Riyal	SR
Singapore	Dollar	\$S
South Africa	Rand	R
Sweden	Krona	SKr
Switzerland	Franc	SF
United Kingdom	Pound	£
United States	Dollar	\$

TABLE 21.1

International Currency Symbols

foreign exchange market

The market in which one country's currency is traded for another country's currency.

21.2

Excel Master It!



Excel Master coverage online

The foreign exchange market is an over-the-counter market, so there is no single location where traders get together. Instead, market participants are located in the major commercial and investment banks around the world. They communicate using computer terminals, telephones, and other telecommunications devices. One communications network for foreign transactions is maintained by the Society for Worldwide Interbank Financial Telecommunication (SWIFT), a Belgian not-for-profit cooperative. Using data transmission lines, a bank in New York can send messages to a bank in London via SWIFT regional processing centers.

The many different types of participants in the foreign exchange market include the following:

1. Importers who pay for goods using foreign currencies.
2. Exporters who receive foreign currency and may want to convert to the domestic currency.
3. Portfolio managers who buy or sell foreign stocks and bonds.
4. Foreign exchange brokers who match buy and sell orders.
5. Traders who “make a market” in foreign currencies.
6. Speculators who try to profit from changes in exchange rates.



Visit SWIFT at www.swift.com.

exchange rate

The price of one country's currency expressed in terms of another country's currency.

EXCHANGE RATES

An **exchange rate** is the price of one country's currency expressed in terms of another country's currency. In practice, almost all trading of currencies takes place in terms of the U.S. dollar. For example, both the Swiss franc and the Japanese yen are traded with their prices quoted in U.S. dollars. Exchange rates are constantly changing. Our nearby *Work the Web* box shows you how to get up-to-the-minute rates.

WORK THE WEB



You just returned from your dream vacation to Jamaica and feel rich because you have 10,000 Jamaican dollars left over. You now need to convert this to U.S. dollars. How much will you have? You can look up the current exchange rate and do the conversion yourself, or work the web. We went to www.xe.com and used the currency converter on the site to find out. This is what we found:



Looks like you left Jamaica just before you ran out of money.

Questions

1. Using this currency converter, what is the current US\$/Jamaican\$ exchange rate?
2. The website www.xe.com also lists cross-rates. What is the current ¥/€ cross-rate?

Currencies

U.S.-dollar foreign-exchange rates in late New York trading

Country/currency	US\$ vs.			US\$ vs.			
	— Thurs —	in US\$	per US\$	YTD chg	— Thurs —	in US\$	per US\$
Americas							
Argentina peso	.1250	8.0001	22.7				
Brazil real	.4476	2.2339	-5.4				
Canada dollar	.9126	1.0958	3.2				
Chile peso	.001773	564.00	7.3				
Colombia peso	.0005169	1934.50	0.2				
Ecuador US dollar	1	1	unch				
Mexico peso	.0767	13.0434	unch				
Peru new sol	.3561	2.808	0.2				
Uruguay peso	.04379	22.8355	7.8				
Venezuela b. fuerte	.157480	6.3500	unch				
Asia-Pacific							
Australian dollar	.9274	1.0783	-3.9				
1-mos forward	.9255	1.0805	-4.0				
3-mos forward	.9216	1.0851	-4.0				
6-mos forward	.9157	1.0920	-3.9				
China yuan	.1598	6.2590	3.4				
Hong Kong dollar	.1290	7.7528	unch				
India rupee	.01663	60.150	-2.8				
Indonesia rupiah	.0000865	11555	-5.0				
Japan yen	.009773	102.32	-2.8				
1-mos forward	.009775	102.31	-2.9				
3-mos forward	.009778	102.27	-2.9				
6-mos forward	.009784	102.21	-2.9				
Malaysia ringgit	.3062	3.2659	-0.5				
New Zealand dollar	.8633	1.1584	-4.8				
Pakistan rupee	.01014	98.645	-6.4				
Philippines peso	.0224	44.610	0.5				
Singapore dollar	.7982	1.2528	-0.8				
South Korea won	.0009682	1032.80	-2.2				
Taiwan dollar	.03305	30.256	1.1				
Thailand baht	.03090	32.367	-11				
Vietnam dong	.00004742	21090	-0.2				
				Close	Net Chg	% Chg	YTD% Chg
				WSJ Dollar Index	72.85	-0.01	-0.01
							-1.31

FIGURE 21.1
Exchange Rate Quotations

SOURCE: *The Wall Street Journal*, 2014.



Get up-to-the-minute exchange rates at
www.xe.com and
www.exchangerate.com.

Exchange Rate Quotations Figure 21.1 reproduces exchange rate quotations as they appeared in *The Wall Street Journal* in 2014. The second column (labeled “in US\$”) gives the number of dollars it takes to buy one unit of foreign currency. Because this is the price in dollars of a foreign currency, it is called a *direct* or *American quote* (remember that “Americans are direct”). For example, the Australian dollar is quoted at .9274, which means you can buy one Australian dollar with U.S. \$.9274.

The third column shows the *indirect*, or European, exchange rate (even though the currency may not be European). This is the amount of foreign currency per U.S. dollar. The Australian dollar is quoted here at 1.0783, so you can get 1.0783 Australian dollars for one U.S. dollar. Naturally, this second exchange rate is the reciprocal of the first one (possibly with a small rounding error), $1/.9274 = 1.0783$.

Cross-Rates and Triangle Arbitrage Using the U.S. dollar as the common denominator in quoting exchange rates greatly reduces the number of possible cross-currency quotes. With five major currencies, there would potentially be 10 exchange rates instead of four.¹

¹There are four exchange rates instead of five because one exchange rate would involve the exchange of a currency for itself. More generally, it might seem that there should be 25 exchange rates with five currencies. There are 25 different combinations, but, of these, five involve the exchange of a currency for itself. Of the remaining 20, half are redundant because they are just the reciprocals of another exchange rate. Of the remaining 10, six can be eliminated by using a common denominator.

Also, the fact that the dollar is used throughout decreases inconsistencies in the exchange rate quotations.

EXAMPLE 21.1

A Yen for Euros

Suppose you have \$1,000. Based on the rates in Figure 21.1, how many Japanese yen can you get? Alternatively, if a Porsche costs €100,000 (recall that € is the symbol for the euro), how many dollars will you need to buy it?

The exchange rate in terms of yen per dollar (third column) is 102.32. Your \$1,000 will thus get you:

$$\$1,000 \times 102.32 \text{ yen per } \$1 = 102,320 \text{ yen}$$

To buy the Porsche, because the exchange rate in terms of dollars per euro (second column) is 1.3869, you will need:

$$\text{€}100,000 \times \$1.3869 \text{ per } \text{€} = \$138,690$$

Earlier, we defined the cross-rate as the exchange rate for a non-U.S. currency expressed in terms of another non-U.S. currency. Suppose we observe the following for the euro (€) and the Swiss franc (SF):

$$\text{€ per } \$1 = 1.00$$

$$\text{SF per } \$1 = 2.00$$

Suppose the cross-rate is quoted as:

$$\text{€ per SF} = .40$$

What do you think?

The cross-rate here is inconsistent with the exchange rates. To see this, suppose you have \$100. If you convert this to Swiss francs, you will receive:

$$\$100 \times \text{SF } 2 \text{ per } \$1 = \text{SF } 200$$

If you convert this to euros at the cross-rate, you will have:

$$\text{SF } 200 \times \text{€}.4 \text{ per SF } 1 = \text{€}80$$

However, if you convert your dollars to euros without going through Swiss francs, you will have:

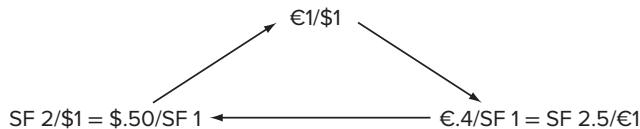
$$\$100 \times \text{€}1 \text{ per } \$1 = \text{€}100$$

What we see is that the euro has two prices, €1 per \$1 and €.80 per \$1, with the price we pay depending on how we get the euros.

To make money, we want to buy low and sell high. The important thing to note is that euros are cheaper if you buy them with dollars because you get 1 euro instead of just .8. You should proceed as follows:

1. Buy 100 euros for \$100.
2. Use the 100 euros to buy Swiss francs at the cross-rate. Because it takes .4 euros to buy a Swiss franc, you will receive $\text{€}100/.4 = \text{SF } 250$.
3. Use the SF 250 to buy dollars. Because the exchange rate is SF 2 per dollar, you receive $\text{SF } 250/2 = \$125$, for a round-trip profit of \$25.
4. Repeat Steps 1 through 3.

This particular activity is called *triangle arbitrage* because the arbitrage involves moving through three different exchange rates:



To prevent such opportunities, it is not difficult to see that because a dollar will buy you either 1 euro or 2 Swiss francs, the cross-rate must be:

$$(\text{€1}/\$1)/(\text{SF } 2/\$1) = \text{€1}/\text{SF } 2$$

That is, the cross-rate must be 1 euro per 2 Swiss francs. If it were anything else, there would be a triangle arbitrage opportunity.

Shedding Some Pounds

EXAMPLE 21.2

Suppose the exchange rates for the British pound and Swiss franc are:

$$\begin{aligned} \text{Pounds per } \$1 &= .60 \\ \text{SF per } \$1 &= 2.00 \end{aligned}$$

The cross-rate is three francs per pound. Is this consistent? Explain how to make some money.

The cross-rate should be $\text{SF } 2.00/\text{£}.60 = \text{SF } 3.33$ per pound. You can buy a pound for SF 3 in one market, and you can sell a pound for SF 3.33 in another. So, we want to first get some francs, then use the francs to buy some pounds, and then sell the pounds. Assuming you have \$100, you could:

1. Exchange dollars for francs: $\$100 \times 2 = \text{SF } 200$.
2. Exchange francs for pounds: $\text{SF } 200/3 = \text{£}66.67$.
3. Exchange pounds for dollars: $\text{£}66.67/.60 = \$111.11$.

This would result in an \$11.11 round-trip profit.



For international news and events, visit www.ft.com.

Types of Transactions There are two basic types of trades in the foreign exchange market: Spot trades and forward trades. A **spot trade** is an agreement to exchange currency “on the spot,” which actually means that the transaction will be completed or settled within two business days. The exchange rate on a spot trade is called the **spot exchange rate**. Implicitly, all of the exchange rates and transactions we have discussed so far have referred to the spot market.

A **forward trade** is an agreement to exchange currency at some time in the future. The exchange rate that will be used is agreed upon today and is called the **forward exchange rate**. A forward trade will normally be settled sometime in the next 12 months.

If you look back at Figure 21.1, you will see forward exchange rates quoted for some of the major currencies. Suppose the spot exchange rate for the Swiss franc is SF 1 = \$1.1373. The 180-day (6-month) forward exchange rate is SF 1 = \$1.1391. This means you can buy a Swiss franc today for \$1.1373, or you can agree to take delivery of a Swiss franc in 180 days and pay \$1.1391 at that time.

Notice that the Swiss franc is more expensive in the forward market (\$1.1391 versus \$1.1373). Because the Swiss franc is more expensive in the future than it is today, it is said

spot trade

An agreement to trade currencies based on the exchange rate today for settlement within two business days.

spot exchange rate

The exchange rate on a spot trade.

forward trade

An agreement to exchange currency at some time in the future.

forward exchange rate

The agreed-upon exchange rate to be used in a forward trade.

to be selling at a *premium* relative to the dollar. For the same reason, the dollar is said to be selling at a *discount* relative to the Swiss franc.

Why does the forward market exist? One answer is that it allows businesses and individuals to lock in a future exchange rate today, thereby eliminating any risk from unfavorable shifts in the exchange rate.

EXAMPLE 21.3

Looking Forward

Suppose you are expecting to receive a million British pounds in six months, and you agree to a forward trade to exchange your pounds for dollars. Based on Figure 21.1, how many dollars will you get in six months? Is the pound selling at a discount or a premium relative to the dollar?

In Figure 21.1, the spot exchange rate and the 180-day forward rate in terms of dollars per pound are $\$1.6893 = £1$ and $\$1.6867 = £1$, respectively. If you expect £1 million in 180 days, you will get $£1\text{ million} \times \$1.6867 \text{ per pound} = \1.6867 million . Because it is less expensive to buy a pound in the forward market than in the spot market ($\$1.6867$ versus $\$1.6893$), the pound is said to be selling at a discount relative to the dollar.

As we mentioned earlier, it is standard practice around the world (with a few exceptions) to quote exchange rates in terms of the U.S. dollar. This means rates are quoted as the amount of currency per U.S. dollar. For the remainder of this chapter, we will stick with this form. Things can get extremely confusing if you forget this point. When we say things like “the exchange rate is expected to rise,” it is important to remember that we are talking about the exchange rate quoted as units of foreign currency per dollar.

Concept Questions

- 21.2a** What is triangle arbitrage?
- 21.2b** What do we mean by the 90-day forward exchange rate?
- 21.2c** If we say that the exchange rate is SF 1.90, what do we mean?

21.3 Purchasing Power Parity

Now that we have discussed what exchange rate quotations mean, we can address an obvious question: What determines the level of the spot exchange rate? In addition, because we know that exchange rates change through time, we can ask the related question: What determines the rate of change in exchange rates? At least part of the answer in both cases goes by the name of **purchasing power parity (PPP)**: The idea that the exchange rate adjusts to keep purchasing power constant among currencies. As we discuss next, there are two forms of PPP, *absolute* and *relative*.

purchasing power parity (PPP)

The idea that the exchange rate adjusts to keep purchasing power constant among currencies.

ABSOLUTE PURCHASING POWER PARITY

The basic idea behind *absolute purchasing power parity* is that a commodity costs the same regardless of what currency is used to purchase it or where it is selling. This is a straightforward concept. If a beer costs £2 in London, and the exchange rate is £.60 per dollar, then a beer costs $£2/.60 = \$3.33$ in New York. In other words,

absolute PPP says that \$1 will buy you the same number of, say, cheeseburgers anywhere in the world.

More formally, let S_0 be the spot exchange rate between the British pound and the U.S. dollar today (Time 0), and remember that we are quoting exchange rates as the amount of foreign currency per dollar. Let P_{US} and P_{UK} be the current U.S. and British prices, respectively, on a particular commodity like apples. Absolute PPP says that:

$$P_{UK} = S_0 \times P_{US}$$

This tells us that the British price for something is equal to the U.S. price for that same thing multiplied by the exchange rate.

The rationale behind PPP is similar to that behind triangle arbitrage. If PPP did not hold, arbitrage would be possible (in principle) if apples were moved from one country to another. Suppose apples are selling in New York for \$4 per bushel, whereas in London the price is £2.40 per bushel. Absolute PPP implies that:

$$\begin{aligned} P_{UK} &= S_0 \times P_{US} \\ \text{£}2.40 &= S_0 \times \$4 \\ S_0 &= \text{£}2.40/\$4 = \text{£}.60 \end{aligned}$$

That is, the implied spot exchange rate is £.60 per dollar. Equivalently, a pound is worth \$1/£.60 = \$1.67.

Suppose that, instead, the actual exchange rate is £.50. Starting with \$4, a trader could buy a bushel of apples in New York, ship it to London, and sell it there for £2.40. Our trader could then convert the £2.40 into dollars at the prevailing exchange rate, $S_0 = \text{£}.50$, yielding a total of £2.40/.50 = \$4.80. The round-trip gain would be 80 cents.

Because of this profit potential, forces are set in motion to change the exchange rate and/or the price of apples. In our example, apples would begin moving from New York to London. The reduced supply of apples in New York would raise the price of apples there, and the increased supply in Britain would lower the price of apples in London.

In addition to moving apples around, apple traders would be busily converting pounds back into dollars to buy more apples. This activity would increase the supply of pounds and simultaneously increase the demand for dollars. We would expect the value of a pound to fall. This means that the dollar would be getting more valuable, so it would take more pounds to buy one dollar. Because the exchange rate is quoted as pounds per dollar, we would expect the exchange rate to rise from £.50.

For absolute PPP to hold absolutely, several things must be true:

1. The transactions costs of trading apples—shipping, insurance, spoilage, and so on—must be zero.
2. There must be no barriers to trading apples—no tariffs, taxes, or other political barriers.
3. Finally, an apple in New York must be identical to an apple in London. It won't do for you to send red apples to London if the English eat only green apples.

Given the fact that the transactions costs are not zero and that the other conditions are rarely exactly met, it is not surprising that absolute PPP is really applicable only to traded goods, and then only to very uniform ones.

For this reason, absolute PPP does not imply that a Mercedes costs the same as a Ford or that a nuclear power plant in France costs the same as one in New York. In the case of the cars, they are not identical. In the case of the power plants, even if they were identical, they are expensive and would be very difficult to ship. On the other hand, we would be surprised to see a significant violation of absolute PPP for gold.



Check out the most recent Big Mac Index at www.economist.com/content/big-mac-index.

The Economist publishes the Big Mac Index, which shows whether a currency is overvalued or undervalued relative to the U.S. dollar based on the price of a McDonald's Big Mac. In the January 2017 index, two of the 43 currencies in the index were overvalued by more than 10 percent, and 39 currencies were undervalued by more than 10 percent.

RELATIVE PURCHASING POWER PARITY

As a practical matter, a relative version of purchasing power parity has evolved. *Relative purchasing power parity* does not tell us what determines the absolute level of the exchange rate. Instead, it tells what determines the *change* in the exchange rate over time.

The Basic Idea Suppose the British pound–U.S. dollar exchange rate is currently $S_0 = £.50$. Further suppose that the inflation rate in Britain is predicted to be 10 percent over the coming year, and (for the moment) the inflation rate in the United States is predicted to be zero. What do you think the exchange rate will be in a year?

If you think about it, you see that a dollar currently costs .50 pounds in Britain. With 10 percent inflation, we expect prices in Britain to generally rise by 10 percent. So we expect that the price of a dollar will go up by 10 percent, and the exchange rate should rise to $£.50 \times 1.1 = £.55$.

If the inflation rate in the United States is not zero, then we need to worry about the *relative* inflation rates in the two countries. Suppose the U.S. inflation rate is predicted to be 4 percent. Relative to prices in the United States, prices in Britain are rising at a rate of $10\% - 4\% = 6\%$ per year. So we expect the price of the dollar to rise by 6 percent, and the predicted exchange rate is $£.50 \times 1.06 = £.53$.

The Result In general, relative PPP says that the change in the exchange rate is determined by the difference in the inflation rates of the two countries. To be more specific, we will use the following notation:

S_0 = Current (Time 0) spot exchange rate (foreign currency per dollar)

$E(S_t)$ = Expected exchange rate in t periods

h_{US} = Inflation rate in the United States

h_{FC} = Foreign country inflation rate

Based on our preceding discussion, relative PPP says that the expected percentage change in the exchange rate over the next year, $[E(S_1) - S_0]/S_0$, is:

$$[E(S_1) - S_0]/S_0 = h_{FC} - h_{US}$$

21.1

In words, relative PPP says that the expected percentage change in the exchange rate is equal to the difference in inflation rates. If we rearrange this slightly, we get:

$$E(S_1) = S_0 \times [1 + (h_{FC} - h_{US})]$$

21.2

This result makes a certain amount of sense, but care must be used in quoting the exchange rate.

In our example involving Britain and the United States, relative PPP tells us that the exchange rate will rise by $h_{FC} - h_{US} = 10\% - 4\% = 6\%$ per year. Assuming the difference in inflation rates doesn't change, the expected exchange rate in two years, $E(S_2)$, will be:

$$\begin{aligned} E(S_2) &= E(S_1) \times (1 + .06) \\ &= .53 \times 1.06 \\ &= .562 \end{aligned}$$

Notice that we could have written this as:

$$\begin{aligned} E(S_2) &= .53 \times 1.06 \\ &= .50 \times (1.06 \times 1.06) \\ &= .50 \times 1.06^2 \end{aligned}$$

In general, relative PPP says that the expected exchange rate at some time in the future, $E(S_t)$, is:

$$E(S_t) = S_0 \times [1 + (h_{FC} - h_{US})]^t$$

21.3

As we will see, this is a very useful relationship.

Because we don't really expect absolute PPP to hold for most goods, we will focus on relative PPP in our following discussion. Henceforth, when we refer to PPP without further qualification, we mean relative PPP.

It's All Relative

EXAMPLE 21.4

Suppose the Japanese exchange rate is currently 105 yen per dollar. The inflation rate in Japan over the next three years will run, say, 2 percent per year, whereas the U.S. inflation rate will be 6 percent. Based on relative PPP, what will the exchange rate be in three years?

Because the U.S. inflation rate is higher, we expect that a dollar will become less valuable. The exchange rate change will be $2\% - 6\% = -4\%$ per year. Over three years, the exchange rate will fall to:

$$\begin{aligned} E(S_3) &= S_0 \times [1 + (h_{FC} - h_{US})]^3 \\ &= 105 \times [1 + (-.04)]^3 \\ &= 92.90 \end{aligned}$$

Currency Appreciation and Depreciation We frequently hear things like "the dollar strengthened (or weakened) in financial markets today" or "the dollar is expected to appreciate (or depreciate) relative to the pound." When we say that the dollar strengthens or appreciates, we mean that the value of a dollar rises, so it takes more foreign currency to buy a dollar.

What happens to the exchange rates as currencies fluctuate in value depends on how exchange rates are quoted. Because we are quoting them as units of foreign currency per dollar, the exchange rate moves in the same direction as the value of the dollar: It rises as the dollar strengthens, and falls as the dollar weakens.

Relative PPP tells us that the exchange rate will rise if the U.S. inflation rate is lower than the foreign country's inflation rate. This happens because the foreign currency depreciates in value and weakens relative to the dollar.

Concept Questions

21.3a What does absolute PPP say? Why might it not hold for many types of goods?

21.3b According to relative PPP, what determines the change in exchange rates?

21.4 Interest Rate Parity, Unbiased Forward Rates, and the International Fisher Effect

The next issue we need to address is the relationship between spot exchange rates, forward exchange rates, and interest rates. To get started, we need some additional notation:

F_t = Forward exchange rate for settlement at Time t

R_{US} = U.S. nominal risk-free interest rate

R_{FC} = Foreign country nominal risk-free interest rate

As before, we will use S_0 to stand for the spot exchange rate. You can take the U.S. nominal risk-free rate, R_{US} , to be the T-bill rate.

COVERED INTEREST ARBITRAGE

Suppose we observe the following information about U.S. and Swiss currency in the market:

$$S_0 = \text{SF } 2.00$$

$$F_1 = \text{SF } 1.90$$

$$R_{US} = 10\%$$

$$R_s = 5\%$$

where R_s is the nominal risk-free rate in Switzerland. The period is one year, so F_1 is the 360-day forward rate.

Do you see an arbitrage opportunity here? There is one. Suppose you have \$1 to invest, and you want a riskless investment. One option you have is to invest the \$1 in a riskless U.S. investment such as a 360-day T-bill. If you do this, then, in one period, your \$1 will be worth:

$$\begin{aligned}\$ \text{ value in 1 period} &= \$1 \times (1 + R_{US}) \\ &= \$1.10\end{aligned}$$

Alternatively, you can invest in the Swiss risk-free investment. To do this, you need to convert your \$1 to Swiss francs and simultaneously execute a forward trade to convert francs back to dollars in one year. The necessary steps would be as follows:

1. Convert your \$1 to $\$1 \times S_0 = \text{SF } 2.00$.
2. At the same time, enter into a forward agreement to convert Swiss francs back to dollars in one year. Because the forward rate is SF 1.90, you will get \$1 for every SF 1.90 that you have in one year.
3. Invest your SF 2.00 in Switzerland at R_s . In one year, you will have:

$$\begin{aligned}\$ \text{ value in 1 year} &= \text{SF } 2.00 \times (1 + R_s) \\ &= \text{SF } 2.00 \times 1.05 \\ &= \text{SF } 2.10\end{aligned}$$

4. Convert your SF 2.10 back to dollars at the agreed-upon rate of SF 1.90 = \$1. You end up with:

$$\begin{aligned}\$ \text{ value in 1 year} &= \text{SF } 2.10 / 1.90 \\ &= \$1.1053\end{aligned}$$



For exchange rates and even pictures of non-U.S. currencies, see www.travlang.com/money.

Notice that the value in one year resulting from this strategy can be written as:

$$\begin{aligned}\$ \text{ value in 1 year} &= \$1 \times S_0 \times (1 + R_s)/F_1 \\ &= \$1 \times 2 \times 1.05/1.90 \\ &= \$1.1053\end{aligned}$$

The return on this investment is apparently 10.53 percent. This is higher than the 10 percent we get from investing in the United States. Because both investments are risk-free, there is an arbitrage opportunity.

To exploit the difference in interest rates, you need to borrow, say, \$5 million at the lower U.S. rate and invest it at the higher Swiss rate. What is the round-trip profit from doing this? To find out, we can work through the steps outlined previously:

1. Convert the \$5 million at SF 2 = \$1 to get SF 10 million.
2. Agree to exchange Swiss francs for dollars in one year at SF 1.90 to the dollar.
3. Invest the SF 10 million for one year at $R_s = 5\%$. You end up with SF 10.5 million.
4. Convert the SF 10.5 million back to dollars to fulfill the forward contract. You receive SF 10.5 million/1.90 = \$5,526,316.
5. Repay the loan with interest. You owe \$5 million plus 10 percent interest, for a total of \$5.5 million. You have \$5,526,316, so your round-trip profit is a risk-free \$26,316.

The activity that we have illustrated here goes by the name of *covered interest arbitrage*. The term *covered* refers to the fact that we are covered in the event of a change in the exchange rate because we lock in the forward exchange rate today.

INTEREST RATE PARITY

If we assume that significant covered interest arbitrage opportunities do not exist, then there must be some relationship between spot exchange rates, forward exchange rates, and relative interest rates. To see this relationship, we can look at the general implications from the two strategies in the previous discussion. Strategy 1, investing in a riskless U.S. investment, gives us $1 + R_{us}$ for every dollar we invest. Strategy 2, investing in a foreign risk-free investment, gives us $S_0 \times (1 + R_{fc})/F_1$ for every dollar we invest. Because these have to be equal to prevent arbitrage, it must be the case that:

$$1 + R_{us} = S_0 \times (1 + R_{fc})/F_1$$

Rearranging this a bit gets us the famous **interest rate parity (IRP)** condition:

$$F_1/S_0 = (1 + R_{fc})/(1 + R_{us})$$

There is a very useful approximation for IRP that illustrates very clearly what is going on and is not difficult to remember. If we define the percentage forward premium or discount as $(F_1 - S_0)/S_0$, then IRP says that this percentage premium or discount is *approximately* equal to the difference in interest rates:

$$(F_1 - S_0)/S_0 = R_{fc} - R_{us}$$

Very loosely, what IRP says is that any difference in interest rates between two countries for some period is just offset by the change in the relative value of the currencies, thereby eliminating any arbitrage possibilities. Notice that we could also write:

$$F_1 = S_0 \times [1 + (R_{fc} - R_{us})]$$

In general, if we have t periods instead of just one, the IRP approximation is written as:

$$F_t = S_0 \times [1 + (R_{fc} - R_{us})]^t$$

interest rate parity (IRP)

The condition stating that the interest rate differential between two countries is equal to the percentage difference between the forward exchange rate and the spot exchange rate.

21.4

21.5

21.6

EXAMPLE 21.5**Parity Check**

Suppose the exchange rate for Japanese yen, S_0 , is currently ¥120 = \$1. If the interest rate in the United States is $R_{us} = 10\%$ and the interest rate in Japan is $R_j = 5\%$, then what must the forward rate be to prevent covered interest arbitrage?

From IRP, we have:

$$\begin{aligned} F_1 &= S_0 \times [1 + (R_j - R_{us})] \\ &= ¥120 \times [1 + (.05 - .10)] \\ &= ¥120 \times .95 \\ &= ¥114 \end{aligned}$$

Notice that the yen will sell at a premium relative to the dollar (why?).

FORWARD RATES AND FUTURE SPOT RATES**unbiased forward rates (UFR)**

The condition stating that the current forward rate is an unbiased predictor of the future spot exchange rate.



How are the international markets doing? Find out at www.marketwatch.com.

In addition to PPP and IRP, we need to discuss one more basic relationship. What is the connection between the forward rate and the expected future spot rate? The **unbiased forward rates (UFR)** condition says that the forward rate, F_1 , is equal to the *expected* future spot rate, $E(S_1)$:

$$F_1 = E(S_1)$$

With t periods, UFR would be written as:

$$F_t = E(S_t)$$

Loosely, the UFR condition says that, on average, the forward exchange rate is equal to the future spot exchange rate.

If we ignore risk, then the UFR condition should hold. Suppose the forward rate for the Japanese yen is consistently lower than the future spot rate by, say, 10 yen. This means that anyone who wanted to convert dollars to yen in the future would consistently get more yen by not agreeing to a forward exchange. The forward rate would have to rise to interest anyone in a forward exchange.

Similarly, if the forward rate were consistently higher than the future spot rate, then anyone who wanted to convert yen to dollars would get more dollars per yen by not agreeing to a forward trade. The forward exchange rate would have to fall to attract such traders.

For these reasons, the forward and actual future spot rates should be equal to each other, on average. What the future spot rate will actually be is uncertain, of course. The UFR condition may not hold if traders are willing to pay a premium to avoid this uncertainty. If the condition does hold, then the 180-day forward rate that we see today should be an unbiased predictor of what the exchange rate will actually be in 180 days.

PUTTING IT ALL TOGETHER

We have developed three relationships, PPP, IRP, and UFR, that describe the interaction between key financial variables such as interest rates, exchange rates, and inflation rates. We now explore the implications of these relationships as a group.

Uncovered Interest Parity To start, it is useful to collect our international financial market relationships in one place:

$$\text{PPP: } E(S_1) = S_0 \times [1 + (h_{FC} - h_{US})]$$

$$\text{IRP: } F_1 = S_0 \times [1 + (R_{FC} - R_{US})]$$

$$\text{UFR: } F_1 = E(S_1)$$

We begin by combining UFR and IRP. Because we know that $F_1 = E(S_1)$ from the UFR condition, we can substitute $E(S_1)$ for F_1 in IRP. The result is:

$$\text{UIP: } E(S_1) = S_0 \times [1 + (R_{FC} - R_{US})]$$

This important relationship is called **uncovered interest parity (UIP)**, and it will play a key role in our international capital budgeting discussion that follows. With t periods, UIP becomes:

$$E(S_t) = S_0 \times [1 + (R_{FC} - R_{US})]^t$$

The International Fisher Effect Next, we compare PPP and UIP. Both of them have $E(S_t)$ on the left-hand side, so their right-hand sides must be equal. We have that:

$$\begin{aligned} S_0 \times [1 + (h_{FC} - h_{US})] &= S_0 \times [1 + (R_{FC} - R_{US})] \\ h_{FC} - h_{US} &= R_{FC} - R_{US} \end{aligned}$$

This tells us that the difference in returns between the United States and a foreign country is equal to the difference in inflation rates. Rearranging this slightly gives us the **international Fisher effect (IFE)**:

$$R_{US} - h_{US} = R_{FC} - h_{FC}$$

The IFE says that *real* rates are equal across countries.²

The conclusion that real returns are equal across countries is really basic economics. If real returns were higher in Brazil than in the United States, money would flow out of U.S. financial markets and into Brazilian markets. Asset prices in Brazil would rise and their returns would fall. At the same time, asset prices in the United States would fall and their returns would rise. This process acts to equalize real returns.

Having said all this, we need to note a couple of things. First of all, we really haven't explicitly dealt with risk in our discussion. We might reach a different conclusion about real returns once we do, particularly if people in different countries have different tastes and attitudes toward risk. Second, there are many barriers to the movement of money and capital around the world. Real returns might be different in two different countries for long periods of time if money can't move freely between them.

Despite these problems, we expect that capital markets will become increasingly internationalized. As this occurs, any differences in real rates that do exist will probably diminish. The laws of economics have very little respect for national boundaries.

uncovered interest parity (UIP)

The condition stating that the expected percentage change in the exchange rate is equal to the difference in interest rates.

international Fisher effect (IFE)

The theory that real interest rates are equal across countries.

21.7

Concept Questions

21.4a What is covered interest arbitrage?

21.4b What is the international Fisher effect?

²Notice that our result here is in terms of the approximate real rate, $R - h$ (see Chapter 7), because we used approximations for PPP and IRP. For the exact result, see Problem 18 at the end of the chapter.

21.5 International Capital Budgeting

Kihlstrom Equipment, a U.S.-based international company, is evaluating an overseas investment. Kihlstrom's exports of drill bits have increased to such a degree that it is considering building a distribution center in France. The project will cost €2 million to launch. The cash flows are expected to be €.9 million per year for the next three years.

The current spot exchange rate for euros is €.5. Recall that this is euros per dollar, so a euro is worth \$1/€.5 = \$2. The risk-free rate in the United States is 5 percent, and the risk-free rate in "Euroland" is 7 percent. Note that the exchange rate and the two interest rates are observed in financial markets, not estimated.³ Kihlstrom's required return on dollar investments of this sort is 10 percent.

Should Kihlstrom take this investment? As always, the answer depends on the NPV; but how do we calculate the net present value of this project in U.S. dollars? There are two basic methods:

1. *The home currency approach:* Convert all the euro cash flows into dollars, and then discount at 10 percent to find the NPV in dollars. Notice that for this approach, we have to come up with the future exchange rates to convert the future projected euro cash flows into dollars.
2. *The foreign currency approach:* Determine the required return on euro investments, and discount the euro cash flows to find the NPV in euros. Then convert this euro NPV to a dollar NPV. This approach requires us to somehow convert the 10 percent dollar required return to the equivalent euro required return.

The difference between these two approaches is primarily a matter of when we convert from euros to dollars. In the first case, we convert before estimating the NPV. In the second case, we convert after estimating NPV.

It might appear that the second approach is superior because we have to come up with only one number, the euro discount rate. Furthermore, because the first approach requires us to forecast future exchange rates, it probably seems that there is greater room for error with this approach. As we illustrate next, based on our previous results, the two approaches are really the same.

METHOD 1: THE HOME CURRENCY APPROACH

To convert the project's future cash flows into dollars, we will invoke the uncovered interest parity, or UIP, relationship to come up with the projected exchange rates. Based on our earlier discussion, the expected exchange rate at Time t , $E(S_t)$, is:

$$E(S_t) = S_0 \times [1 + (R_\epsilon - R_{US})]^t$$

where R_ϵ stands for the nominal risk-free rate in Euroland. Because R_ϵ is 7 percent, R_{US} is 5 percent, and the current exchange rate (S_0) is €.5:

$$\begin{aligned} E(S_t) &= .5 \times [1 + (.07 - .05)]^t \\ &= .5 \times 1.02^t \end{aligned}$$

³For example, the interest rates might be the short-term Eurodollar and euro deposit rates offered by large money center banks.

The projected exchange rates for the drill bit project are:

Year	Expected Exchange Rate
1	$\text{€.5} \times 1.02^1 = \text{€.5100}$
2	$\text{€.5} \times 1.02^2 = \text{€.5202}$
3	$\text{€.5} \times 1.02^3 = \text{€.5306}$

Using these exchange rates, along with the current exchange rate, we can convert all of the euro cash flows to dollars:

Year	(1) Cash Flow in €mil	(2) Expected Exchange Rate	(3) Cash Flow in \$mil (1)/(2)
0	−€2.0	€.5000	−\$4.00
1	.9	.5100	1.76
2	.9	.5202	1.73
3	.9	.5306	1.70

To finish, we calculate the NPV in the usual way:

$$\begin{aligned} \text{NPV}_\$ &= -\$4 + \$1.76/1.10 + \$1.73/1.10^2 + \$1.70/1.10^3 \\ &= \$.3 \text{ million} \end{aligned}$$

So, the project appears to be profitable.

METHOD 2: THE FOREIGN CURRENCY APPROACH

Kihlstrom requires a nominal return of 10 percent on the dollar-denominated cash flows. We need to convert this to a rate suitable for euro-denominated cash flows. Based on the international Fisher effect, we know that the difference in the nominal rates is:

$$\begin{aligned} R_\epsilon - R_{US} &= h_\epsilon - h_{US} \\ &= 7\% - 5\% = 2\% \end{aligned}$$

The appropriate discount rate for estimating the euro cash flows from the drill bit project is approximately equal to 10 percent plus an extra 2 percent to compensate for the greater euro inflation rate.

If we calculate the NPV of the euro cash flows at this rate, we get:

$$\begin{aligned} \text{NPV}_\epsilon &= -\epsilon 2 + \epsilon.9/1.12 + \epsilon.9/1.12^2 + \epsilon.9/1.12^3 \\ &= \epsilon.16 \text{ million} \end{aligned}$$

The NPV of this project is €.16 million. Taking this project makes us €.16 million richer today. What is this in dollars? Because the exchange rate today is €.5, the dollar NPV of the project is:

$$\text{NPV}_\$ = \text{NPV}_\epsilon / S_0 = \epsilon.16 / .5 = \$.3 \text{ million}$$

This is the same dollar NPV that we previously calculated.

The important thing to recognize from our example is that the two capital budgeting procedures are actually the same and will always give the same answer.⁴ In this second

⁴Actually, there will be a slight difference because we are using the approximate relationships. If we calculate the required return as $1.10 \times (1 + .02) - 1 = 12.2\%$, then we get exactly the same NPV. See Problem 18 for more detail.

approach, the fact that we are implicitly forecasting exchange rates is hidden. Even so, the foreign currency approach is computationally a little easier.

UNREMITTED CASH FLOWS

The previous example assumed that all aftertax cash flows from the foreign investment could be remitted to (paid out to) the parent firm. Actually, substantial differences can exist between the cash flows generated by a foreign project and the amount that can actually be remitted, or “repatriated,” to the parent firm.

A foreign subsidiary can remit funds to a parent in many forms, including the following:

1. Dividends.
2. Management fees for central services.
3. Royalties on the use of trade names and patents.

However cash flows are repatriated, international firms must pay special attention to remittances because there may be current and future controls on remittances. Many governments are sensitive to being exploited by foreign national firms. In such cases, governments are tempted to limit the ability of international firms to remit cash flows. Funds that cannot currently be remitted are sometimes said to be *blocked*.

Concept Questions

21.5a What financial complications arise in international capital budgeting?

Describe two procedures for estimating NPV in the case of an international project.

21.5b What are blocked funds?

21.6 Exchange Rate Risk

exchange rate risk

The risk related to having international operations in a world where relative currency values vary.

Exchange rate risk is the natural consequence of international operations in a world where relative currency values move up and down. Managing exchange rate risk is an important part of international finance. As we discuss next, there are three different types of exchange rate risk, or exposure: Short-run exposure, long-run exposure, and translation exposure. Chapter 23 contains a more detailed discussion of the issues raised in this section.

SHORT-RUN EXPOSURE

The day-to-day fluctuations in exchange rates create short-run risks for international firms. Most such firms have contractual agreements to buy and sell goods in the near future at set prices. When different currencies are involved, such transactions have an extra element of risk.

Imagine that you are importing imitation pasta from Italy and reselling it in the United States under the Impasta brand name. Your largest customer has ordered 10,000 cases of Impasta. You place the order with your supplier today, but you won’t pay until the goods arrive in 60 days. Your selling price is \$6 per case. Your cost is 8.4 euros per case, and the exchange rate is currently €1.50; so it takes 1.50 euros to buy \$1.

At the current exchange rate, your cost in dollars of filling the order is $\$8.4/1.5 = \5.60 per case, so your pretax profit on the order is $10,000 \times (\$6 - \$5.60) = \$4,000$. The exchange rate in 60 days will probably be different, so your actual profit will depend on what the future exchange rate turns out to be.

If the rate goes to €1.6, your cost is $\text{€}8.4/1.6 = \$5.25$ per case. Your profit goes to \$7,500. If the exchange rate goes to €1.4, then your cost is $\text{€}8.4/1.4 = \$6$, and your profit is zero.

The short-run exposure in our example can be reduced or eliminated in several ways. The most obvious way is by entering into a forward exchange agreement to lock in an exchange rate. Suppose the 60-day forward rate is €1.58. What will your profit be if you hedge? What profit should you expect if you don't hedge?

If you hedge, you lock in an exchange rate of €1.58. Your cost in dollars will be $\text{€}8.4/1.58 = \$5.32$ per case, so your profit will be $10,000 \times (\$6 - \$5.32) = \$6,835$. If you don't hedge, then, assuming that the forward rate is an unbiased predictor (in other words, assuming the UFR condition holds), you should expect that the exchange rate will actually be €1.58 in 60 days. You should expect to make \$6,835.

Alternatively, if this strategy is unfeasible, you could borrow the dollars today, convert them into euros, and invest the euros for 60 days to earn some interest. Based on IRP, this amounts to entering into a forward contract.

LONG-RUN EXPOSURE

In the long run, the value of a foreign operation can fluctuate because of unanticipated changes in relative economic conditions. Imagine that we own a labor-intensive assembly operation located in another country to take advantage of lower wages. Through time, unexpected changes in economic conditions can raise the foreign wage levels to the point where the cost advantage is eliminated or even becomes negative.

The impact of changes in exchange rate levels can be substantial. During early 2017, the U.S. dollar continued to strengthen against other currencies. This meant domestic manufacturers took home more for each dollar's worth of sales they made, which can lead to big profit swings. For example, during 2016, IBM estimated that it lost almost \$140 million due to currency swings, which is a lot, but way less than the \$1.7 billion it lost in 2015. The dramatic effect of exchange rate movements on profitability is also shown by the analysis done by Iluka Resources, Ltd., an Australian mining company, which stated that a one-cent movement in the Australian dollar–U.S. dollar exchange rate would change its net income by \$5 million.

Hedging long-run exposure is more difficult than hedging short-term risks. For one thing, organized forward markets don't exist for such long-term needs. Instead, the primary option that firms have is to try to match up foreign currency inflows and outflows. The same thing goes for matching foreign currency-denominated assets and liabilities. A firm that sells in a foreign country might try to concentrate its raw material purchases and labor expense in that country. That way, the dollar values of its revenues and costs will move up and down together. Probably the best examples of this type of hedging are the so-called transplant auto manufacturers such as BMW, Honda, Mercedes, and Toyota, which now build a substantial portion of the cars they sell in the United States, thereby obtaining some degree of immunization against exchange rate movements.

For example, BMW produces 400,000 cars in South Carolina and exports about 280,000 of them. The costs of manufacturing the cars are paid mostly in dollars; when BMW exports the cars to Europe, it receives euros. When the dollar weakens, these vehicles become more profitable for BMW. At the same time, BMW exports about 200,000 cars to the United States each year. The costs of manufacturing these cars imported into the U.S. are mostly in euros, so they become less profitable when the dollar weakens. Taken together, these gains and losses tend to offset each other and provide BMW with a natural hedge. In fact, according to the German Association of the Automotive Industry, about 60 percent of German-owned company autos manufactured in the U.S. are exported.

Similarly, a firm can reduce its long-run exchange rate risk by borrowing in the foreign country. Fluctuations in the value of the foreign subsidiary's assets will then be at least partially offset by changes in the value of the liabilities.

TRANSLATION EXPOSURE

When a U.S. company calculates its accounting net income and EPS for some period, it must “translate” everything into dollars. This can create some problems for the accountants when there are significant foreign operations. In particular, two issues arise:

1. What is the appropriate exchange rate to use for translating each balance sheet account?
2. How should balance sheet accounting gains and losses from foreign currency translation be handled?

To illustrate the accounting problem, suppose we started a small foreign subsidiary in Lilliputia a year ago. The local currency is the gulliver, abbreviated GL. At the beginning of the year, the exchange rate was $GL\ 2 = \$1$, and the balance sheet in gullivers looked like this:

Assets	GL 1,000	Liabilities	GL 500
		Equity	500

At two gullivers to the dollar, the beginning balance sheet in dollars was as follows:

Assets	\$500	Liabilities	\$250
		Equity	250

Lilliputia is a quiet place, and nothing at all actually happened during the year. As a result, net income was zero (before consideration of exchange rate changes). However, the exchange rate did change to $4\ gullivers = \$1$, purely because the Lilliputian inflation rate is much higher than the U.S. inflation rate.

Because nothing happened, the accounting ending balance sheet in gullivers is the same as the beginning one. If we convert it to dollars at the new exchange rate, we get:

Assets	\$250	Liabilities	\$125
		Equity	125

Notice that the value of the equity has gone down by \$125, even though net income was exactly zero. Despite the fact that nothing really happened, there is a \$125 accounting loss. How to handle this \$125 loss has been a controversial accounting question.

One obvious and consistent way to handle this loss is to report the loss on the parent’s income statement. During periods of volatile exchange rates, this kind of treatment can dramatically impact an international company’s reported EPS. This is purely an accounting phenomenon; even so, such fluctuations are disliked by some financial managers.

The current approach to handling translation gains and losses is based on rules set out in the Financial Accounting Standards Board (FASB) *Statement of Financial Accounting Standards No. 52* (FASB 52), issued in December 1981. For the most part, FASB 52 requires that all assets and liabilities be translated from the subsidiary’s currency into the parent’s currency using the exchange rate that currently prevails.

Any translation gains and losses that occur are accumulated in a special account within the shareholders’ equity section of the balance sheet. This account might be labeled something like “unrealized foreign exchange gains (losses).” The amounts involved can be substantial, at least from an accounting standpoint. For example, IBM’s December 31, 2016, fiscal year-end balance sheet shows an increase in equity in the amount of \$5.4 billion for translation adjustments related to assets and liabilities of non-U.S. subsidiaries. These gains and losses are not reported on the income statement. As a result, the impact of translation

gains and losses will not be recognized explicitly in net income until the underlying assets and liabilities are sold or otherwise liquidated.

MANAGING EXCHANGE RATE RISK

For a large multinational firm, the management of exchange rate risk is complicated by the fact that there can be many different currencies involved in many different subsidiaries. A change in an exchange rate will likely benefit some subsidiaries and hurt others. The net effect on the overall firm depends on its net exposure.

Suppose a firm has two divisions. Division A buys goods in the United States for dollars and sells them in Britain for pounds. Division B buys goods in Britain for pounds and sells them in the United States for dollars. If these two divisions are of roughly equal size in terms of their inflows and outflows, then the overall firm obviously has little exchange rate risk.

In our example, the firm's net position in pounds (the amount coming in less the amount going out) is small, so the exchange rate risk is small. However, if one division, acting on its own, were to start hedging its exchange rate risk, then the overall firm's exchange rate risk would go up. The moral of the story is that multinational firms have to be conscious of their overall positions in a foreign currency. For this reason, management of exchange rate risk is probably best handled on a centralized basis.

Concept Questions

- 21.6a** What are the different types of exchange rate risk?
- 21.6b** How can a firm hedge short-run exchange rate risk? Long-run exchange rate risk?

Political Risk

One final element of risk in international investing is **political risk**. Political risk refers to changes in value that arise as a consequence of political actions. For example, in June 2016, British voters shocked the rest of Europe when they voted in favor of "Brexit," the U.K. exit from the European Union. Although the treaty that tied the U.K. to the rest of Europe required a two-year process to complete the withdrawal, financial markets didn't take that long to react. The British pound dropped 11 percent against the U.S. dollar on the day, and London's FTSE and Stoxx Europe 600 stock market indexes dropped about 8 percent. Preeminent British banks Barclays and Lloyds Banking Group were both hit even harder, as they saw stock price drops of more than 30 percent on the day. Unfortunately (or fortunately, depending on your view), the drop in the British pound wasn't finished. It continued to fall against the U.S. dollar, reaching its lowest level since 1985.

21.7

political risk

Risk related to changes in value that arise because of political actions.

THE TAX CUTS AND JOBS ACT OF 2017

In our chapter opener, we described the large cash balances held "overseas" by U.S. corporations. As we noted, the reason Apple and other large U.S. corporations held such large balances overseas has to do with U.S. tax law. Tax laws are a form of political risk faced by multinational firms.

Specifically, before the signing of the Tax Cuts and Jobs Act of 2017, the U.S. had corporate tax rates that were among the highest in the developed world. At the same time, the U.S. was somewhat unique in that it taxed corporate profits wherever they were earned, but only after the profits were brought back, or "repatriated," to the U.S. But what does this mean, exactly?

To answer, let's go back to Lilliputia, which has a 20 percent corporate tax rate, compared to what would have been 35 percent in the U.S. If we earned a profit in our Lilliputian subsidiary, that subsidiary would pay taxes to Lilliputia at the 20 percent rate. If we had left the profits in Lilliputia, then no additional taxes were owed. But, if we had brought the profits back to the U.S., we would have owed additional taxes of 15 percent, the difference between the U.S. and Lilliputian tax rates. Avoiding this extra tax gave U.S. companies a strong incentive *not* to repatriate profits.

Here is where it gets confusing. In the media, companies like Apple are depicted as having huge piles of cash sitting outside the borders of the U.S., but that's not what is really going on. Apple's cash is actually mostly in dollars, and it is mostly invested in various U.S. financial assets. So, the money isn't really "outside" the U.S.

Instead, because Apple has chosen not to pay the extra tax on its overseas profits, it is prohibited from using that cash inside the U.S. to do things like pay dividends or build new facilities. Note that Apple can easily get around this limitation by, for example, borrowing against its cash and securities portfolio if it chooses to do so.

The Tax Cuts and Jobs Act of 2017 changed things in a number of ways. First, the new flat 21 percent tax rate (down from a maximum of 35 percent) reduced the incentive to leave cash overseas. Second, the law imposed a one-time tax of 15.5 percent on cash, securities, and receivables, and a one-time tax of 8 percent on other, less liquid assets (e.g., plant, property, and equipment) purchased with untaxed overseas dollars. Finally, broadly speaking, new repatriated earnings are no longer subject to additional U.S. taxes, thereby eliminating the repatriation issue.

MANAGING POLITICAL RISK

Some countries have more political risk than others, of course. When firms operate in these riskier countries, the extra political risk may lead the firms to require higher returns on overseas investments to compensate for the possibility that funds may be blocked, critical operations interrupted, and contracts abrogated. In the most extreme case, the possibility of outright confiscation may be a concern in countries with relatively unstable political environments.

Political risk also depends on the nature of the business; some businesses are less likely to be confiscated because they are not particularly valuable in the hands of a different owner. An assembly operation supplying subcomponents that only the parent company uses would not be an attractive "takeover" target, for example. Similarly, a manufacturing operation that requires the use of specialized components from the parent is of little value without the parent company's cooperation.

Natural resource developments, such as copper mining or oil drilling, are just the opposite. Once the operation is in place, much of the value is in the commodity. The political risk for such investments is much higher for this reason. Also, the issue of exploitation is more pronounced with such investments, again increasing the political risk.

Political risk can be hedged in several ways, particularly when confiscation or nationalization is a concern. The use of local financing, perhaps from the government of the foreign country in question, reduces the possible loss because the company can refuse to pay the debt in the event of unfavorable political activities. Based on our discussion in this section, structuring the operation in such a way that it requires significant parent company involvement to function is another way to reduce political risk.



A great site for evaluating the political risk of a country is www.cia.gov/library/publications/the-world-factbook/index.html.

Concept Questions

- 21.7a** What is political risk?
- 21.7b** What are some ways of hedging political risk?

Summary and Conclusions

21.8

The international firm has a more complicated life than the purely domestic firm. Management must understand the connection between interest rates, foreign currency exchange rates, and inflation, and it must become aware of many different financial market regulations and tax systems. This chapter is intended to be a concise introduction to some of the financial issues that come up in international investing.

Our coverage has been necessarily brief. The main topics we discussed are the following:

1. *Some basic vocabulary:* We briefly defined some exotic terms such as *LIBOR* and *Eurocurrency*.
2. *The basic mechanics of exchange rate quotations:* We discussed the spot and forward markets and how exchange rates are interpreted.
3. *The fundamental relationships between international financial variables:*
 - a. Absolute and relative purchasing power parity, PPP.
 - b. Interest rate parity, IRP.
 - c. Unbiased forward rates, UFR.

Absolute purchasing power parity states that \$1 should have the same purchasing power in each country. This means that an orange costs the same whether you buy it in New York or in Tokyo.

Relative purchasing power parity means that the expected percentage change in exchange rates between the currencies of two countries is equal to the difference in their inflation rates.

Interest rate parity implies that the percentage difference between the forward exchange rate and the spot exchange rate is equal to the interest rate differential. We showed how covered interest arbitrage forces this relationship to hold.

The unbiased forward rates condition indicates that the current forward rate is a good predictor of the future spot exchange rate.

4. *International capital budgeting:* We showed that the basic foreign exchange relationships imply two other conditions:
 - a. Uncovered interest parity.
 - b. The international Fisher effect.

By invoking these two conditions, we learned how to estimate NPVs in foreign currencies and how to convert foreign currencies into dollars to estimate NPV in the usual way.

5. *Exchange rate and political risk:* We described the various types of exchange rate risk and discussed some commonly used approaches to managing the effect of fluctuating exchange rates on the cash flows and value of the international firm. We also discussed political risk and some ways of managing exposure to it.
6. *The Tax Cuts and Jobs Act of 2017:* We explained the much-discussed “repatriation” issue and how the Act changed a number of tax-related incentives for multinational corporations.

CONNECT TO FINANCE



connect[®]

For more practice, you should be using *Connect Finance*. Log on to connect.mheducation.com to get started!

Can you answer the following Connect Quiz questions?

- Section 21.1** United Travel is exchanging a fixed-rate payment for Foreign Travel's variable-rate payment. This exchange is called a(n) _____.
- Section 21.3** Roger purchased a cell phone in Canada for Can\$189. The exchange rate is \$1 = Can\$1.08. If absolute purchasing power parity exists, what is the price of this same phone in the United States?
- Section 21.6** When will a U.S. firm recognize, for income statement purposes, any accounting gain or loss the firm has from converting a firm's foreign balance sheet into U.S. dollars?

CHAPTER REVIEW AND SELF-TEST PROBLEMS

- 21.1 Relative Purchasing Power Parity** The inflation rate in the United States is projected at 3 percent per year for the next several years. The New Zealand inflation rate is projected to be 5 percent during that time. The exchange rate is currently NZ\$1.66. Based on relative PPP, what is the expected exchange rate in two years?
- 21.2 Covered Interest Arbitrage** The spot and 360-day forward rates on the Swiss franc are SF 2.1 and SF 1.9, respectively. The risk-free interest rate in the United States is 6 percent, and the risk-free rate in Switzerland is 4 percent. Is there an arbitrage opportunity here? How would you exploit it?

ANSWERS TO CHAPTER REVIEW AND SELF-TEST PROBLEMS

- 21.1** Based on relative PPP, the expected exchange rate in two years, $E(S_2)$, is:

$$E(S_2) = S_0 \times [1 + (h_{NZ} - h_{US})]^2$$

where h_{NZ} is the New Zealand inflation rate. The current exchange rate is NZ\$1.66, so the expected exchange rate is:

$$\begin{aligned} E(S_2) &= \text{NZ\$}1.66 \times [1 + (.05 - .03)]^2 \\ &= \text{NZ\$}1.66 \times 1.02^2 \\ &= \text{NZ\$}1.73 \end{aligned}$$

- 21.2** Based on interest rate parity, the forward rate should be (approximately):

$$\begin{aligned} F_1 &= S_0 \times [1 + (R_{SF} - R_{US})] \\ &= \text{SF } 2.1 \times [1 + (.04 - .06)] \\ &= \text{SF } 2.06 \end{aligned}$$

Because the forward rate is actually SF 1.9, there is an arbitrage opportunity.

To exploit the arbitrage opportunity, you first note that dollars are selling for SF 1.9 each in the forward market. Based on IRP, this is too cheap because they should be selling for SF 2.06. So you want to arrange to buy dollars with Swiss francs in the forward market. To do this, you can:

1. *Today:* Borrow, say, \$1 million for 360 days. Convert it to SF 2.1 million in the spot market, and buy a forward contract at SF 1.9 to convert it back to dollars in 360 days. Invest the SF 2.1 million at 4 percent.
2. *In one year:* Your investment has grown to SF 2.1 million \times 1.04 = **SF 2.184** million. Convert this to dollars at the rate of SF 1.9 = \$1. You will have SF 2.184 million/1.9 = **\$1,149,474**. Pay off your loan with 6 percent interest at a cost of \$1 million \times 1.06 = **\$1,060,000** and pocket the difference of \$89,474.

CONCEPTS REVIEW AND CRITICAL THINKING QUESTIONS

1. **Spot and Forward Rates [LO1]** Suppose the exchange rate for the Swiss franc is quoted as SF 1.50 in the spot market and SF 1.53 in the 90-day forward market.
 - a. Is the dollar selling at a premium or a discount relative to the franc?
 - b. Does the financial market expect the franc to strengthen relative to the dollar? Explain.
 - c. What do you suspect is true about relative economic conditions in the United States and Switzerland?
2. **Purchasing Power Parity [LO2]** Suppose the rate of inflation in Mexico will run about 3 percent higher than the U.S. inflation rate over the next several years. All other things being the same, what will happen to the Mexican peso-U.S. dollar exchange rate? What relationship are you relying on in answering?
3. **Exchange Rates [LO1]** The exchange rate for the Australian dollar is currently A\$1.40. This exchange rate is expected to rise by 10 percent over the next year.
 - a. Is the Australian dollar expected to get stronger or weaker?
 - b. What do you think about the relative inflation rates in the United States and Australia?
 - c. What do you think about the relative nominal interest rates in the United States and Australia? Relative real rates?
4. **Yankee Bonds [LO3]** Which of the following most accurately describes a Yankee bond?
 - a. A bond issued by General Motors in Japan with the interest payable in U.S. dollars.
 - b. A bond issued by General Motors in Japan with the interest payable in yen.
 - c. A bond issued by Toyota in the United States with the interest payable in yen.
 - d. A bond issued by Toyota in the United States with the interest payable in dollars.
 - e. A bond issued by Toyota worldwide with the interest payable in dollars.
5. **Exchange Rates [LO3]** Are exchange rate changes necessarily good or bad for a particular company?
6. **International Risks [LO4]** At one point, Duracell International confirmed that it was planning to open battery-manufacturing plants in China and India. Manufacturing in these countries allows Duracell to avoid import duties of between 30 and 35 percent that have made alkaline batteries prohibitively expensive for some consumers. What additional advantages might Duracell see in this proposal? What are some of the risks to Duracell?
7. **Multinational Corporations [LO3]** Given that many multinationals based in many countries have much greater sales outside their domestic markets than within them, what is the particular relevance of their domestic currency?
8. **Exchange Rate Movements [LO3]** Are the following statements true or false? Explain why.
 - a. If the general price index in Great Britain rises faster than that in the United States, we would expect the pound to appreciate relative to the dollar.
 - b. Suppose you are a German machine tool exporter, and you invoice all of your sales in foreign currency. Further suppose that the Euroland monetary authorities begin to undertake an expansionary monetary policy. If it is certain that the easy money policy will result in higher inflation rates in Euroland relative to those in other countries, you should use the forward markets to protect yourself against future losses resulting from the deterioration in the value of the euro.
 - c. If you could accurately estimate differences in the relative inflation rates of two countries over a long period while other market participants were unable to do so, you could successfully speculate in spot currency markets.

- 9. Exchange Rate Movements [LO3]** Some countries encourage movements in their exchange rate relative to those of some other country as a short-term means of addressing foreign trade imbalances. For each of the following scenarios, evaluate the impact the announcement would have on an American importer and an American exporter doing business with the foreign country:
- Officials in the administration of the U.S. government announce that they are comfortable with a rising euro relative to the dollar.
 - British monetary authorities announce that they feel the pound has been driven too low by currency speculators relative to the dollar.
 - The Brazilian government announces that it will print billions of new reals and inject them into the economy in an effort to reduce the country's unemployment rate.
- 10. International Capital Market Relationships [LO2]** We discussed five international capital market relationships: relative PPP, IRP, UFR, UIP, and the international Fisher effect. Which of these would you expect to hold most closely?

QUESTIONS AND PROBLEMS



BASIC

(Questions 1–13)

- Using Exchange Rates [LO1]** Take a look back at Figure 21.1 to answer the following questions:
 - If you have \$100, how many euros can you get?
 - How much is one euro worth?
 - If you have 5 million euros, how many dollars do you have?
 - Which is worth more, a New Zealand dollar or a Singapore dollar?
 - Which is worth more, a Mexican peso or a Chilean peso?
 - How many Mexican pesos can you get for a euro? What do you call this rate?
 - Per unit, what is the most valuable currency of those listed? The least valuable?
- Using the Cross-Rate [LO1]** Use the information in Figure 21.1 to answer the following questions:
 - Which would you rather have, \$100 or £100? Why?
 - Which would you rather have, 100 Swiss francs (SF) or £100? Why?
 - What is the cross-rate for Swiss francs in terms of British pounds? For British pounds in terms of Swiss francs?
- Forward Exchange Rates [LO1]** Use the information in Figure 21.1 to answer the following questions:
 - What is the six-month forward rate for the Japanese yen in yen per U.S. dollar? Is the yen selling at a premium or a discount? Explain.
 - What is the three-month forward rate for Australian dollars in U.S. dollars per Australian dollar? Is the dollar selling at a premium or a discount? Explain.
 - What do you think will happen to the value of the dollar relative to the yen and the Australian dollar, based on the information in the figure? Explain.
- Using Spot and Forward Exchange Rates [LO1]** Suppose the spot exchange rate for the Canadian dollar is Can\$1.29 and the six-month forward rate is Can\$1.31.
 - Which is worth more, a U.S. dollar or a Canadian dollar?
 - Assuming absolute PPP holds, what is the cost in the United States of an Elkhead beer if the price in Canada is Can\$2.50? Why might the beer actually sell at a different price in the United States?

- c. Is the U.S. dollar selling at a premium or a discount relative to the Canadian dollar?
 - d. Which currency is expected to appreciate in value?
 - e. Which country do you think has higher interest rates—the United States or Canada? Explain.
5. **Cross-Rates and Arbitrage [LO1]** Suppose the Japanese yen exchange rate is $\text{¥}114 = \$1$, and the British pound exchange rate is $\text{£}1 = \$1.26$. X
- a. What is the cross-rate in terms of yen per pound?
 - b. Suppose the cross-rate is $\text{¥}147 = \text{£}1$. Is there an arbitrage opportunity here? If there is, explain how to take advantage of the mispricing and the potential arbitrage profit. What is your arbitrage profit per dollar used?
6. **Interest Rate Parity [LO2]** Use Figure 21.1 to answer the following questions: Suppose interest rate parity holds, and the current six-month risk-free rate in the United States is 1.3 percent. What must the six-month risk-free rate be in Great Britain? In Japan? In Switzerland?
7. **Interest Rates and Arbitrage [LO2]** The treasurer of a major U.S. firm has \$30 million to invest for three months. The interest rate in the United States is .28 percent per month. The interest rate in Great Britain is .31 percent per month. The spot exchange rate is £.791, and the three-month forward rate is £.803. Ignoring transaction costs, in which country would the treasurer want to invest the company's funds? Why?
8. **Inflation and Exchange Rates [LO2]** Suppose the current exchange rate for the Polish zloty is Z 4.04. The expected exchange rate in three years is Z 4.13. What is the difference in the annual inflation rates for the United States and Poland over this period? Assume that the anticipated rate is constant for both countries. What relationship are you relying on in answering?
9. **Exchange Rate Risk [LO3]** Suppose your company imports computer motherboards from Singapore. The exchange rate is given in Figure 21.1. You have just placed an order for 30,000 motherboards at a cost to you of 218.50 Singapore dollars each. You will pay for the shipment when it arrives in 90 days. You can sell the motherboards for \$185 each. Calculate your profit if the exchange rate goes up or down by 10 percent over the next 90 days. What is the break-even exchange rate? What percentage rise or fall does this represent in terms of the Singapore dollar versus the U.S. dollar?
10. **Exchange Rates and Arbitrage [LO2]** Suppose the spot and six-month forward rates on the Norwegian krone are Kr 8.39 and Kr 8.48, respectively. The annual risk-free rate in the United States is 3.8 percent, and the annual risk-free rate in Norway is 5.7 percent.
- a. Is there an arbitrage opportunity here? If so, how would you exploit it?
 - b. What must the six-month forward rate be to prevent arbitrage?
11. **The International Fisher Effect [LO2]** You observe that the inflation rate in the United States is 3.5 percent per year and that T-bills currently yield 4.1 percent annually. Using the approximate international Fisher effect, what do you estimate the inflation rate to be in:
- a. Australia, if short-term Australian government securities yield 4 percent per year?
 - b. Canada, if short-term Canadian government securities yield 7 percent per year?
 - c. Taiwan, if short-term Taiwanese government securities yield 9 percent per year?
12. **Spot versus Forward Rates [LO1]** Suppose the spot and three-month forward rates for the yen are ¥113.65 and ¥113.18, respectively.
- a. Is the yen expected to get stronger or weaker?

INTERMEDIATE

(Questions 14–16)

- b.** What would you estimate is the difference between the annual inflation rates of the United States and Japan?
- 13. Expected Spot Rates [LO2]** Suppose the spot exchange rate for the Hungarian forint is HUF 289.97. The inflation rate in the United States will be 2.9 percent per year. It will be 4.5 percent in Hungary. What do you predict the exchange rate will be in one year? In two years? In five years? What relationship are you using?
- 14. Capital Budgeting [LO2]** Lakonishok Equipment has an investment opportunity in Europe. The project costs €10.5 million and is expected to produce cash flows of €1.7 million in Year 1, €2.4 million in Year 2, and €3.3 million in Year 3. The current spot exchange rate is €0.94/\$ and the current risk-free rate in the United States is 2.3 percent, compared to that in Europe of 1.8 percent. The appropriate discount rate for the project is estimated to be 13 percent, the U.S. cost of capital for the company. In addition, the subsidiary can be sold at the end of three years for an estimated €7.9 million. What is the NPV of the project?
- 15. Capital Budgeting [LO2]** You are evaluating a proposed expansion of an existing subsidiary located in Switzerland. The cost of the expansion would be SF 13.8 million. The cash flows from the project would be SF 3.9 million per year for the next five years. The dollar required return is 12 percent per year, and the current exchange rate is SF 1.09. The going rate on Eurodollars is 5 percent per year. It is 4 percent per year on Euroswiss.
- a.** What do you project will happen to exchange rates over the next four years?
 - b.** Based on your answer in (a), convert the projected franc flows into dollar flows and calculate the NPV.
 - c.** What is the required return on franc flows? Based on your answer, calculate the NPV in francs and then convert to dollars.
- 16. Translation Exposure [LO3]** Atreides International has operations in Arrakis. The balance sheet for this division in Arrakeen solaris shows assets of 38,000 solaris, debt in the amount of 12,000 solaris, and equity of 26,000 solaris.
- a.** If the current exchange ratio is 1.50 solaris per dollar, what does the balance sheet look like in dollars?
 - b.** Assume that one year from now the balance sheet in solaris is exactly the same as at the beginning of the year. If the exchange rate is 1.60 solaris per dollar, what does the balance sheet look like in dollars now?
 - c.** Rework part (b) assuming the exchange rate is 1.41 solaris per dollar.
- 17. Translation Exposure [LO3]** In Problem 16, assume the equity increases by 1,250 solaris due to retained earnings. If the exchange rate at the end of the year is 1.54 solaris per dollar, what does the balance sheet look like?
- 18. Using the Exact International Fisher Effect [LO2]** From our discussion of the Fisher effect in Chapter 7, we know that the actual relationship between a nominal rate, R , a real rate, r , and an inflation rate, h , can be written as:

$$1 + r = (1 + R)/(1 + h)$$

This is the *domestic* Fisher effect.

- a.** What is the nonapproximate form of the international Fisher effect?
- b.** Based on your answer in (a), what is the exact form for UIP? (*Hint:* Recall the exact form of IRP and use UFR.)
- c.** What is the exact form for relative PPP? (*Hint:* Combine your previous two answers.)
- d.** Recalculate the NPV for the Kihlstrom drill bit project (discussed in Section 21.5) using the exact forms for UIP and the international Fisher effect. Verify that you get precisely the same answer either way.

CHALLENGE

(Questions 17–18)

EXCEL MASTER IT! PROBLEM

The St. Louis Federal Reserve has historical exchange rates on its website, www.stlouisfed.org. On the website, look for the FRED® data. Download the exchange rate with U.S. dollars over the past five years for the following currencies: Brazilian reals, Canadian dollars, Hong Kong dollars, Japanese yen, Mexican pesos, South Korean won, Indian rupees, Swiss francs, Australian dollars, and the euro. Graph the exchange rate for each of these currencies in a dashboard that can be printed on one page.



MINICASE

S&S Air Goes International

Mark Sexton and Todd Story, the owners of S&S Air, have been in discussions with a light aircraft dealer in Monaco about selling the company's planes in Europe. Jarek Jachowicz, the dealer, wants to add S&S Air to his current retail line. Jarek has told Mark and Todd that he feels the retail sales will be approximately €5.7 million per month. All sales will be made in euros, and Jarek will retain 5 percent of retail sales as a commission, which will be paid in euros. Because the planes will be customized to order, the first sales will take place in one month. Jarek will pay S&S Air for the order 90 days after it is filled. This payment schedule will continue for the length of the contract between the two companies.

Mark and Todd are confident the company can handle the extra volume with its existing facilities, but they are unsure about the potential financial risks of selling their planes in Europe. In their discussion with Jarek, they found that the current exchange rate is \$1.09/€. At the current exchange rate, the company would spend 80 percent of the sales on production costs. This number does not reflect the sales commission paid to Jarek.

Mark and Todd have decided to ask Chris Guthrie, the company's financial analyst, to prepare an analysis of the proposed international sales. Specifically, they ask Chris to answer the following questions.

QUESTIONS

1. What are the pros and cons of the international sales? What additional risks will the company face?
2. What happens to the company's profits if the dollar strengthens? What if the dollar weakens?
3. Ignoring taxes, what are S&S Air's projected gains or losses from this proposed arrangement at the current exchange rate of \$1.09/€? What happens to profits if the exchange rate changes to \$1.03/€? At what exchange rate will the company break even?
4. How could the company hedge its exchange rate risk? What are the implications for this approach?
5. Taking all factors into account, should the company pursue the international sales further? Why or why not?

Behavioral Finance: Implications for Financial Management

THE NASDAQ STOCK MARKET WAS RAGING in the late 1990s, gaining about 23 percent in 1996, 14 percent in 1997, 35 percent in 1998, and 87 percent in 1999. Of course, that spectacular run came to a jarring halt, and the NASDAQ lost about 40 percent in 2000, followed by another 30 percent in 2001. The ISDEX, an index of Internet-related stocks, rose from 100 in January 1996 to 1,100 in February 2000, a gain of 1,000 percent! It then fell like a rock to 600 by May 2000. A bubble can exist on a single asset, as well. For example, many investors saw a tech bubble echo in Tesla Motors, which increased more than 590 percent from March 22, 2013, to February 26, 2014. In fact, one analysis of the company's valuation indicated that the stock could be overvalued by about 150 percent. Tesla's stock evidently ran out of juice as it gained only about 12 percent over the next three years.

The performance of the NASDAQ over this period, and particularly the rise and fall of Internet stocks, has been described by many as one of the greatest market “bubbles” in history. The argument is that prices were inflated to economically ridiculous levels before investors came to their senses, which then caused the bubble to pop and prices to plunge. Debate over whether the stock market of the late 1990s really was a bubble has generated much controversy. In this chapter, we introduce the subject of behavioral finance, which deals with questions such as how bubbles can come to exist. Some of the issues we discuss are quite controversial and unsettled. We will describe competing ideas, present some evidence on both sides, and examine the implications for financial managers.

Learning Objectives

After studying this chapter, you should be able to:

- L01** Describe how behaviors such as overconfidence, overoptimism, and confirmation bias can affect decision making.
- L02** Demonstrate how framing effects can result in inconsistent and/or incorrect decisions.
- L03** Show how the use of heuristics can lead to suboptimal financial decisions.
- L04** Define the shortcomings and limitations to market efficiency from the behavioral finance view.

Be honest: Do you think of yourself as a better-than-average driver? If you do, then you are not alone. About 80 percent of the people who are asked this question will say yes. Evidently, we tend to overestimate our abilities behind the wheel. Is the same true when it comes to making financial management decisions?

It will probably not surprise you when we say that human beings sometimes make errors in judgment. How these errors, and other aspects of human behavior, affect financial managers falls under the general heading of “behavioral finance.” In this chapter, our goal is to acquaint you with some common types of mistakes and their financial implications. As you will see, researchers have identified a wide variety of potentially damaging behaviors. By learning to recognize situations in which mistakes are common, you will become a better decision maker, both in the context of financial management and elsewhere.

Introduction to Behavioral Finance

22.1

Sooner or later, you are going to make a financial decision that winds up costing you (and possibly your employer and/or stockholders) a lot of money. Why is this going to happen? You already know the answer. Sometimes, you make sound decisions, but you get unlucky in the sense that something happens that you could not have reasonably anticipated. Other times (however painful to admit), you just make a bad decision, one that could have (and should have) been avoided. The beginning of business wisdom is to recognize the circumstances that lead to poor decisions and thereby cut down on the damage done by financial blunders.

As we have previously noted, the area of research known as **behavioral finance** attempts to understand and explain how reasoning errors influence financial decisions. Much of the research done in the behavioral finance area stems from work in cognitive psychology, which is the study of how people, including financial managers, think, reason, and make decisions. Errors in reasoning are often called *cognitive* errors. In the next several subsections, we will review three main categories of such errors: (1) Biases, (2) framing effects, and (3) heuristics.

behavioral finance
The area of finance dealing with the implications of reasoning errors on financial decisions.

Biases

22.2

If your decisions exhibit systematic biases, then you will make systematic errors in judgment. The type of error depends on the type of bias. In this section, we discuss three particularly relevant biases: (1) Overconfidence, (2) overoptimism, and (3) confirmation bias.

OVERCONFIDENCE

Serious errors in judgment occur in the business world due to **overconfidence**. We are all overconfident about our abilities in at least some areas (recall our earlier question about driving ability). Here is another example that we see a lot: Ask yourself what grade you will receive in this course (in spite of the arbitrary and capricious nature of the professor). In our experience, almost everyone will either say “A” or, at worst, “B.” Sadly, when this happens, we are always confident (but not overconfident) that at least some of our students are going to be disappointed.

overconfidence
The belief that your abilities are better than they really are.

In general, you are overconfident when you overestimate your ability to make the correct choice or decision. Most business decisions require judgments about the unknown future. The belief that you can forecast the future with precision is a common form of overconfidence.

Another good example of overconfidence comes from studies of stock investors. Researchers have examined large numbers of actual brokerage accounts to see how investors fare when they choose stocks. Overconfidence by investors would cause them to overestimate their ability to pick the best stocks, leading to excessive trading. The evidence supports this view. First, investors hurt themselves by trading. The accounts that have the most trading significantly underperform the accounts with the least trading, primarily because of the costs associated with trades.

A second finding is equally interesting. Accounts registered to men underperform those registered to women. The reason is that men trade more on average. This extra trading is consistent with evidence from psychology that men have greater degrees of overconfidence than women.

OVEROPTIMISM

overoptimism

Taking an overly optimistic view of potential outcomes.

Overoptimism leads to overestimating the likelihood of a good outcome and underestimating the likelihood of a bad outcome. Overoptimism and overconfidence are related, but they are not the same thing. An overconfident individual could (overconfidently) forecast a bad outcome, for example.

Optimism is usually thought of as a good thing. Optimistic people have “upbeat personalities” and “sunny dispositions.” However, excessive optimism leads to bad decisions. In a capital budgeting context, overly optimistic analysts will consistently overestimate cash flows and underestimate the probability of failure. Doing so leads to upward-biased estimates of project NPVs, a common occurrence in the business world.

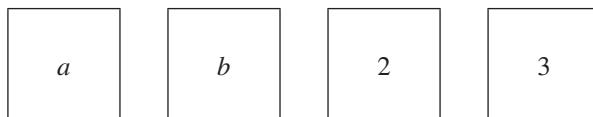
CONFIRMATION BIAS

confirmation bias

Searching for (and giving more weight to) information and opinions that confirm what you believe rather than information and opinions to the contrary.

When you are evaluating a decision, you collect information and opinions. A common bias in this regard is to focus more on information that agrees with your opinion and to downplay or ignore information that doesn't agree with or support your position. This phenomenon is known as **confirmation bias**, and people who suffer from it tend to spend too much time trying to prove themselves correct rather than searching for information that might prove them wrong.

Here is a classic example from psychology. Below are four cards. Notice that the cards are labeled *a*, *b*, 2, and 3. You are asked to evaluate the following statement: “Any card with a vowel on one side has an even number on the other.” You are asked which of the four cards has to be turned over to decide if the statement is true or false. It costs \$100 to turn over a card, so you want to be as economical as possible. What do you do?



You would probably begin by turning over the card with an “*a*” on it, which is correct. If we find an odd number, then we are done because the statement is incorrect.

Suppose we find an even number. What next? Most people will turn over the card with a 2. Is that the right choice? If we find a vowel, then we confirm the statement, but if we find a consonant, we don't learn anything. In other words, this card can't prove that the statement is wrong; it can only confirm it, so selecting this card is an example of confirmation bias.

Continuing, there is no point in turning over the card labeled “*b*” because the statement doesn't say anything about consonants, which leaves us with the last card. Do we have to turn it over? The answer is yes because it might have a vowel on the other side, which would disprove the statement, but most people will choose the 2 card over the 3 card.

Concept Questions

- 22.2a** What is overconfidence? How is it likely to be costly?
- 22.2b** What is overoptimism? How is it likely to be costly?
- 22.2c** What is confirmation bias? How is it likely to be costly?

Framing Effects

22.3

You are susceptible to framing effects if your decisions depend on how a problem or question is framed. Consider the following example: A disaster has occurred, 600 people are at risk, and you are in charge. You must choose between the two following rescue operations:

SCENARIO 1

- Option A: Exactly 200 people will be saved.
- Option B: There is a 1/3 chance that all 600 people will be saved and a 2/3 chance that no people will be saved.

Which would you choose? There is no necessarily right answer, but most people will choose Option A. Now suppose your choices are as follows:

SCENARIO 2

- Option C: Exactly 400 people will die.
- Option D: There is a 1/3 chance that nobody will die and a 2/3 chance that all 600 will die.

Now which do you pick? Again, there is no right answer, but most people will choose Option D.

Although most people will choose Options A and D in our hypothetical scenarios, you probably see that doing so is inconsistent because Options A and C are identical, as are Options B and D. Why do people make inconsistent choices? It's because the options are framed differently. The first scenario is positive because it emphasizes the number that will be saved. The second is negative because it focuses on losses, and people react differently to positive versus negative framing, which is a form of **frame dependence**.

frame dependence
The tendency of individuals to make different (and potentially inconsistent) decisions depending on how a question or problem is framed.

LOSS AVERSION

Here is another example that illustrates a particular type of frame dependence:

SCENARIO 1:

- Suppose we give you \$1,000. You have the following choices:
- Option A: You can receive another \$500 for sure.
 - Option B: You can flip a fair coin. If the coin flip comes up heads, you get another \$1,000, but if it comes up tails, you get nothing.

SCENARIO 2:

- Suppose we give you \$2,000. You have the following choices:
- Option C: You can lose \$500 for sure.
 - Option D: You can flip a fair coin. If the coin flip comes up heads, you lose \$1,000, but if it comes up tails, you lose nothing.

What were your answers? Did you choose Option A in the first scenario and Option D in the second? If that's what you did, you are guilty of just focusing on gains and losses, and not paying attention to what really matters, namely, the impact on your wealth. However,

you are not alone. About 85 percent of the people who are presented with the first scenario choose Option A, and about 70 percent of the people who are presented with the second scenario choose Option D.

If you look closely at the two scenarios, you will see that they are actually identical. You end up with \$1,500 for sure if you pick Option A or C, or else you end up with a 50–50 chance of either \$1,000 or \$2,000 if you pick Option B or D. So, you should pick the same option in both scenarios. Which option you prefer is up to you, but the point is that you should never pick Option A in our first scenario and Option D in our second one.

This example illustrates an important aspect of financial decision making. Focusing on gains and losses instead of overall wealth is an example of *narrow framing*, and it leads to a phenomenon known as *loss aversion*. In fact, the reason that most people avoid Option C in Scenario 2 in our example is that it is expressed as a sure loss of \$500. In general, researchers have found that individuals are reluctant to realize losses and will gamble at unfavorable odds to avoid doing so.

Loss aversion is also known as *get-evenitus* or the *break-even effect* because it frequently shows up as individuals and companies hang on to bad investments and projects (and perhaps even invest more) hoping that something will happen that will allow them to break even and thereby escape without a loss. For example, we discussed the irrelevance of sunk costs in the context of capital budgeting, and the idea of a sunk cost seems clear. Nonetheless, we constantly see companies (and individuals) throw good money after bad rather than just recognize a loss in the face of sunk costs.

How destructive is get-evenitus? Perhaps the most famous case occurred in 1995, when 28-year-old Nicholas Leeson caused the collapse of his employer, the 233-year-old Barings Bank. At the end of 1992, Mr. Leeson had lost about £2 million, which he hid in a secret account. By the end of 1993, his losses were about £23 million, and they mushroomed to £208 million at the end of 1994 (at the time, this was about \$300 million).

Instead of admitting to these losses, Mr. Leeson gambled more of the bank's money in an attempt to "double-up and catch-up." On February 23, 1995, Mr. Leeson's losses were about £827 million (\$1.3 billion), and his trading irregularities were uncovered. Although he attempted to flee from prosecution, he was caught, arrested, tried, convicted, and imprisoned. Also, his wife divorced him.

Do you suffer from get-evenitus? Maybe so. Consider the following scenario: You just lost \$78 somehow. You can just live with the loss, or you can make a bet. If you make the bet, there is an 80 percent chance that your loss will grow to \$100 (from \$78) and a 20 percent chance that your loss will be nothing. Do you take the loss or take the bet? We bet you choose the bet. If you do, you have get-evenitus because the bet is a bad one. Instead of a sure loss of \$78, your expected loss from the bet is $(.80 \times \$100) + (.20 \times \$0) = \$80$.

In corporate finance, loss aversion can be quite damaging. We already mentioned the pursuit of sunk costs. We also might see managers bypassing positive NPV projects because they have the possibility of large losses (perhaps with low probability). Another phenomenon that we see is debt avoidance. As we discuss in our coverage of capital structure, debt financing generates valuable tax shields for profitable companies. Even so, there are hundreds of profitable companies listed on major stock exchanges that completely (or almost completely) avoid debt financing. Because debt financing increases the likelihood of losses and even bankruptcy, this potentially costly behavior could be due to loss aversion.

HOUSE MONEY

Las Vegas casinos know all about a concept called *playing with house money*. The casinos have found that gamblers are far more likely to take big risks with money that they have

won from the casino (i.e., house money). Also, casinos have found that gamblers are not as upset about losing house money as they are about losing the money they brought with them to gamble.

It may seem natural for you to feel that some money is precious because you earned it through hard work, sweat, and sacrifice, while other money is less precious because it came to you as a windfall. But these feelings are plainly irrational because any dollar you have buys the same amount of goods and services no matter how you obtained that dollar.

Let's consider another common situation to illustrate several of the ideas we have explored thus far. Consider the following two investments:

Investment 1: You bought 100 shares in Moore Enterprises for \$35 per share. The shares immediately fell to \$20 each.

Investment 2: At the same time, you bought 100 shares in Miller Co. for \$5 per share. The shares immediately jumped to \$20 each.

How would you feel about your investments?

You would probably feel pretty good about your Miller investment and be unhappy with your Moore investment. Here are some other things that might occur:

1. You might tell yourself that your Miller investment was a great idea on your part; you're a stock-picking genius. The drop in value on the Moore shares wasn't your fault—it was just bad luck. This is a form of confirmation bias, and it also illustrates *self-attribution bias*, which is taking credit for good outcomes that occur for reasons beyond your control, while attributing bad outcomes to bad luck or misfortune.
2. You might be unhappy that your big winner was essentially nullified by your loser, but notice in our example that your overall wealth did not change. Suppose instead that shares in both companies didn't change in price at all, so that your overall wealth was unchanged. Would you feel the same way?
3. You might be inclined to sell your Miller stock to "realize" the gain, but hold on to your Moore stock in hopes of avoiding the loss (which is, of course, loss aversion). The tendency to sell winners and hold losers is known as the *disposition effect*. Plainly, the rational thing to do is to decide if the stocks are attractive investments at their new prices and react accordingly.

Suppose you decide to keep both stocks a little longer. Once you do, both decline to \$15. You might now feel very differently about the decline depending on which stock you looked at. With Moore, the decline makes a bad situation even worse. Now you are down \$20 per share on your investment. On the other hand, with Miller you only "give back" some of your "paper profit." You are still way ahead. This kind of thinking is playing with house money. Whether you lose from your original investment or from your investment gains is irrelevant.

Our Moore and Miller example illustrates what can happen when you become emotionally invested in decisions such as stock purchases. When you add a new stock to your portfolio, it is human nature for you to associate the stock with its purchase price. As the price of the stock changes through time, you will have unrealized gains or losses when you compare the current price to the purchase price. Through time, you will mentally account for these gains and losses, and how you feel about the investment depends on whether you are ahead or behind. This behavior is known as *mental accounting*.

When you engage in mental accounting, you unknowingly have a personal relationship with each of your stocks. As a result, it becomes harder to sell one of them. It is as if you have to "break up" with a stock or "fire" it from your portfolio. As with personal

relationships, these stock relationships can be complicated and, believe it or not, make selling stocks difficult at times. What can you do about mental accounting? Legendary investor Warren Buffett offers the following advice: “The stock doesn’t know you own it. You have feelings about it, but it has no feelings about you. The stock doesn’t know what you paid. People shouldn’t get emotionally involved with their stocks.”

Loss aversion, mental accounting, and the house money effect are important examples of how narrow framing leads to poor decisions. Other, related types of judgment errors have been documented. Here are a few examples:

Myopic loss aversion. This behavior is the tendency to focus on avoiding short-term losses, even at the expense of long-term gains. For example, you might fail to invest in stocks for long-term retirement purposes because you have a fear of loss in the near term.

Regret aversion. This aversion is the tendency to avoid making a decision because you fear that, in hindsight, the decision would have been less than optimal. Regret aversion relates to myopic loss aversion.

Endowment effect. This effect is the tendency to consider something that you own to be worth more than it would be if you did not own it. Because of the endowment effect, people sometimes demand more money to give up something than they would be willing to pay to acquire it.

Money illusion. If you suffer from a money illusion, you are confused between real buying power and nominal buying power (i.e., you do not account for the effects of inflation).

Concept Questions

22.3a What is frame dependence? How is it likely to be costly?

22.3b What is loss aversion? How is it likely to be costly?

22.3c What is the house money effect? Why is it irrational?

22.4 Heuristics

heuristics

Shortcuts or rules of thumb used to make decisions.

affect heuristic

The reliance on instinct instead of analysis in making decisions.

Financial managers (and managers in general) often rely on rules of thumb, or **heuristics**, in making decisions. For example, a manager might decide that any project with a payback period less than two years is acceptable and therefore not bother with additional analysis. As a practical matter, this mental shortcut might be just fine for most circumstances, but we know that sooner or later, it will lead to the acceptance of a negative NPV project.

THE AFFECT HEURISTIC

We frequently hear business and political leaders talk about following their gut instinct. In essence, such people are making decisions based on whether the chosen outcome or path feels “right” emotionally. Psychologists use the term *affect* (as in *affection*) to refer to emotional feelings, and the reliance on gut instinct is called the **affect heuristic**.

Reliance on instinct is closely related to reliance on intuition and/or experience. Both intuition and experience are important and, used properly, help decision makers identify potential risks and rewards. However, instinct, intuition, and experience should be viewed as complements to formal analysis, not substitutes. Overreliance on emotions in making decisions will almost surely lead (at least on occasion) to costly outcomes that could have been avoided with careful, structured thinking. An obvious example would be making

capital budgeting decisions based on instinct rather than on market research and discounted cash flow analysis.

THE REPRESENTATIVENESS HEURISTIC

People often assume that a particular person, object, or outcome is broadly representative of a larger class. Suppose an employer hired a graduate of your high-quality educational institution and, in fact, is quite pleased with that person. The employer might be inclined to look to your school again for future employees because the students are so good. Of course, in doing so, the employer is assuming that the recent hire is representative of all the students, which is an example of the **representativeness heuristic**. A little more generally, the representativeness heuristic is the reliance on stereotypes, analogies, or limited samples to form opinions about an entire class.

representativeness heuristic

The reliance on stereotypes, analogies, or limited samples to form opinions about an entire class.

REPRESENTATIVENESS AND RANDOMNESS

Another implication of the representativeness heuristic has to do with perceiving patterns or causes where none exist. For example, basketball fans generally believe that success breeds success. Suppose we look at the recent performance of two basketball players named LeBron and Shaquille. Both of these players make half of their shots. But, LeBron has just made two shots in a row, while Shaquille has just missed two in a row. Researchers have found that if they ask 100 basketball fans which player has the better chance of making the next shot, 91 of them will say LeBron, because he has a “hot hand.” Further, 84 of these fans believe that it is important for teammates to pass the ball to LeBron after he has made two or three shots in a row.

But, and the sports fans among you will have a hard time with this, researchers have found that the hot hand is an illusion. That is, players really do not deviate much from their long-run shooting averages—although fans, players, announcers, and coaches think they do. In one study, cognitive psychologists actually analyzed the shooting percentage of one professional basketball team for a season. Here is what they found:

Shooting Percentages and the History of Previous Attempts	
Shooting Percentage on Next Shot	History of Previous Attempts
46%	Has made 3 in a row
50	Has made 2 in a row
51	Has made 1 in a row
52	First shot of the game
54	Has missed 1 in a row
53	Has missed 2 in a row
56	Has missed 3 in a row

Detailed analysis of shooting data failed to show that players make or miss shots more or less frequently than what would be expected by chance. That is, statistically speaking, all the shooting percentages listed here are the same.

From the shooting percentages, it may appear that teams will try harder to stop a shooter who has made the last two or three shots. To take this into account, researchers also studied free-throw percentages. Researchers told fans that a certain player was a 70 percent free-throw shooter and was shooting two foul shots. They asked fans to predict what would happen on the second shot if the player:

1. Made the first free throw.
2. Missed the first free throw.

Fans thought that this 70 percent free-throw shooter would make 74 percent of the second free throws after making the first free throw but would only make 66 percent of the second free throws after missing the first free throw. Researchers studied free-throw data from a professional basketball team over two seasons. They found that the result of the first free throw does not matter when it comes to making or missing the second free throw. On average, the shooting percentage on the second free throw was 75 percent when the player made the first free throw. On average, the shooting percentage on the second free throw was also 75 percent when the player missed the first free throw.

It is true that basketball players shoot in streaks. But these streaks are within the bounds of long-run shooting percentages. So, it is an illusion that players are either “hot” or “cold.” If you are a believer in the hot hand you are likely to reject these facts because you “know better” from watching your favorite teams over the years. If you do, you are being fooled by randomness.

The *clustering illusion* is our human belief that random events that occur in clusters are not really random. For example, it strikes most people as very unusual if heads comes up four times in a row during a series of coin flips. However, if a fair coin is flipped 20 times, there is about a 50 percent chance of getting four heads in a row. Ask yourself, if you flip four heads in a row, do you think you have a “hot hand” at coin flipping?

THE GAMBLER'S FALLACY

People commit the *gambler's fallacy* when they assume that a departure from what occurs on average, or in the long run, will be corrected in the short run. Interestingly, some people suffer from both the hot-hand illusion (which predicts continuation in the short run) and the gambler's fallacy (which predicts reversal in the short run)! The idea is that because an event has not happened recently, it has become overdue and is more likely to occur. People sometimes refer (wrongly) to the law of averages in such cases.

Roulette is a random gambling game where gamblers can make various bets on the spin of the wheel. There are 38 numbers on an American roulette table, 2 green ones, 18 red ones, and 18 black ones. One possibility is to bet whether the spin will result in a red number or a black number. Suppose a red number has appeared five times in a row. Gamblers will often become (over) confident that the next spin will be black, when the true chance remains at about 50 percent (of course, it is exactly 18 in 38).

The misconception arises from the human intuition that the overall odds of the wheel must be reflected in a small number of spins. That is, gamblers often become convinced that the wheel is “due” to hit a black number after a series of red numbers. Gamblers do know that the odds of a black number appearing are always unchanged: 18 in 38. But, gamblers cannot help but feel that after a long series of red numbers, a black one must appear to restore the balance between red and black numbers over time.

Of course, there are many other related errors and biases due to heuristics. Here is a partial list:

Law of small numbers. If you believe in the law of small numbers, you believe that a small sample of outcomes always resembles the long-run distribution of outcomes. If your investment guru has been right five out of seven times recently, you might believe that his long-run average of being correct is also five out of seven. The law of small numbers is related to recency bias (see our next item) and to the gambler's fallacy.

Recency bias. Humans tend to give recent events more importance than less recent events. For example, during the great bull market that occurred from 1995 to 1999, many investors thought the market would continue its big gains for a long time—forgetting that bear markets also occur (which happened from 2008 to early 2009). Recency bias is related to the law of small numbers.

Anchoring and adjustment. People have an anchoring bias when they are unable to account for new information in a correct way. That is, they become “anchored” to a previous price or other value and fail to adjust their thinking. If you have an anchoring bias, you will tend to be overly conservative in the face of fresh news.

Aversion to ambiguity. This bias results when people shy away from the unknown. Consider the following choice: You get \$1,000 for sure, or you can draw a ball out of a big bin containing 100 balls. If the ball is blue, you win \$2,000. If it is red, you win nothing. When people are told that there are 50 blue balls and 50 red balls in the bin, about 40 percent choose to draw a ball. When they are told nothing about how many balls in the bin are blue, most choose to take the \$1,000—ignoring the possibility that the odds might really be in their favor. That is, there could be more than 50 blue balls in the bin.

False consensus. This is the tendency to think that other people are thinking the same thing you are thinking (with no real evidence). False consensus relates to overconfidence and confirmation bias.

Availability bias. You suffer from availability bias when you put too much weight on information that is easily available and place too little weight on information that is hard to obtain. Your financial decisions will suffer if you only consider information that is easy to obtain.



Visit www.behaviouralfinance.net for many other terms and concepts of behavioral finance.

Concept Questions

- 22.4a What is the affect heuristic? How is it likely to be costly?
- 22.4b What is the representativeness heuristic? How is it likely to be costly?
- 22.4c What is the gambler's fallacy?

Behavioral Finance and Market Efficiency

22.5

Our discussion thus far has focused on how cognitive errors by individuals can lead to poor business decisions. It seems both clear and noncontroversial that such errors are real and financially important. We now venture into a much less clear area—the implications of behavioral finance for stock prices.

In Chapter 12, we introduced the notion of market efficiency. The key idea is that, in an efficient market, prices fully reflect available information. Put differently, prices are correct in the sense that a stock purchase or sale is a zero NPV investment. In a well-organized, liquid market such as the NYSE, the argument is that competition among profit-motivated, economically rational traders ensures that prices can never drift far from their zero-NPV level.

In this chapter, we have already seen a few examples of how cognitive errors, such as overconfidence, can lead to damaging decisions in the context of stock ownership. If many traders behave in ways that are economically irrational, then is there still reason to think that markets are efficient?

First off, it is important to realize that the efficient markets hypothesis does not require every investor to be rational. Instead, all that is required for a market to be efficient is at least some rational and well-financed investors. These investors are prepared to buy and sell to take advantage of any mispricing in the marketplace. This activity is what keeps markets efficient. It is sometimes said that market efficiency doesn't require that *everyone* be rational, just that *someone* be rational.

LIMITS TO ARBITRAGE

limits to arbitrage

The notion that the price of an asset may not equal its correct value because of barriers to arbitrage.

noise trader

A trader whose trades are not based on information or meaningful financial analysis.

sentiment-based risk

A source of risk to investors above and beyond firm-specific risk and overall market risk.

Investors who buy and sell to exploit mispricings are engaging in a form of *arbitrage* and are known as *arbitrageurs* (or *arbs* for short). Sometimes a problem arises in this context. The term **limits to arbitrage** refers to the notion that, under certain circumstances, it may not be possible for rational, well-capitalized traders to correct a mispricing, at least not quickly. The reason is that strategies designed to eliminate mispricings are often risky, costly, or somehow restricted. Three important such problems are:

- Firm-specific risk.** This issue is the most obvious risk facing a would-be arbitrageur. Suppose that you believe that the observed price on General Motors stock is too low, so you purchase many, many shares. Then, there is some unanticipated negative news that drives the price of General Motors stock even lower. Of course, you could try to hedge some of the firm-specific risk, but any hedge you create is likely to be either imperfect and/or costly.
- Noise trader risk.** A **noise trader** is someone whose trades are not based on information or financially meaningful analysis. Noise traders could, in principle, act together to worsen a mispricing in the short run. Noise trader risk is important because the worsening of a mispricing could force the arbitrageur to liquidate early and sustain steep losses. As Keynes once famously observed, “Markets can remain irrational longer than you can remain solvent.”¹
- Implementation costs.** All trades cost money. In some cases, the cost of correcting a mispricing may exceed the potential gains. Suppose you believe a small, thinly-traded stock is significantly undervalued. You want to buy a large quantity. The problem is that as soon as you try to place a huge order, the price jumps because the stock isn’t heavily traded.

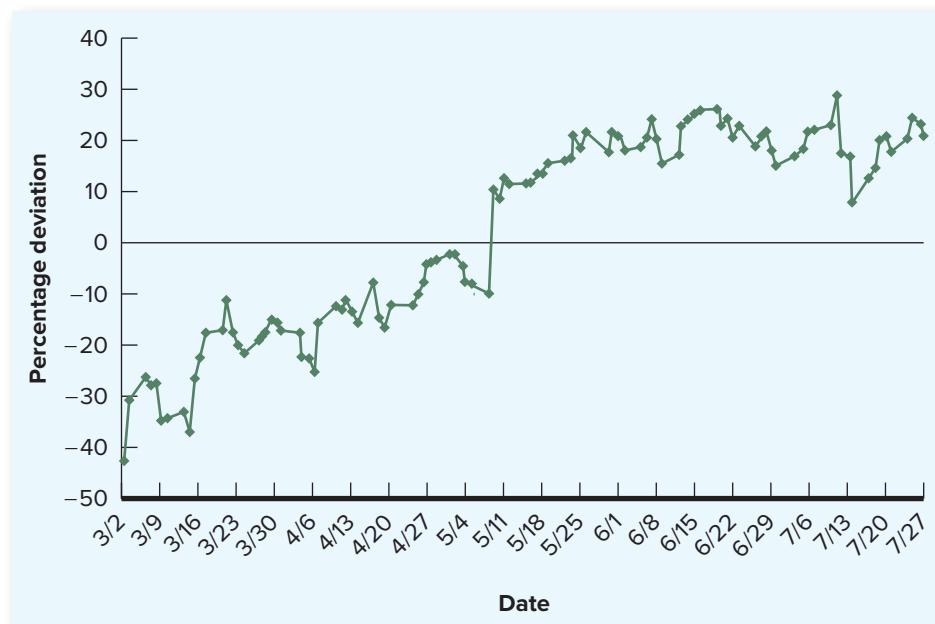
When these or other risks and costs are present, a mispricing may persist because arbitrage is too risky or too costly. Collectively, these risks and costs create barriers or limits to arbitrage. How important these limits are is difficult to say, but we do know that mispricings occur, at least on occasion. To illustrate, we next consider two well-known examples.

The 3Com/Palm Mispricing On March 2, 2000, 3Com, a profitable provider of computer networking products and services, sold 5 percent of its Palm subsidiary to the public via an initial public offering (IPO). 3Com planned to distribute the remaining Palm shares to 3Com shareholders at a later date.² Under the plan, if you owned one share of 3Com, you would receive 1.5 shares of Palm. So, after 3Com sold part of Palm via the IPO, investors could buy Palm shares directly, or they could buy them indirectly by purchasing shares of 3Com.

What makes this case interesting is what happened in the days that followed the Palm IPO. If you owned one 3Com share, you would be entitled, eventually, to 1.5 shares of Palm. Therefore, each 3Com share should be worth *at least* 1.5 times the value of each Palm share. We say *at least* because the other parts of 3Com were profitable. As a result, each 3Com share should have been worth much more than 1.5 times the value of one Palm share. But, as you might guess, things did not work out this way.

¹This remark is generally attributed to Keynes, but whether he actually said it is not known.

²In other words, as we discuss in our chapter on mergers and acquisitions, 3Com did an equity carve-out and planned to subsequently spin off the remaining shares.

**FIGURE 22.1**

The Percentage Deviation between 1 Share of 3Com and 1.5 Shares of Palm, March 2, 2000, to July 27, 2000

The day before the Palm IPO, shares in 3Com sold for \$104.13. After the first day of trading, Palm closed at \$95.06 per share. Multiplying \$95.06 by 1.5 results in \$142.59, which is the minimum value one would expect to pay for 3Com. But the day Palm closed at \$95.06, 3Com shares closed at \$81.81, more than \$60 lower than the price implied by Palm. It gets stranger.

A 3Com price of \$81.81 when Palm is selling for \$95.06 implies that the market values the rest of 3Com's businesses (per share) at: $\$81.81 - \$142.59 = -\$60.78$. Given the number of 3Com shares outstanding at the time, this means the market placed a *negative* value of about -\$22 billion on the rest of 3Com's businesses. Of course, a stock price cannot be negative. This means, then, that the price of Palm relative to 3Com was much too high, and investors should have bought and sold such that the negative value was instantly eliminated.

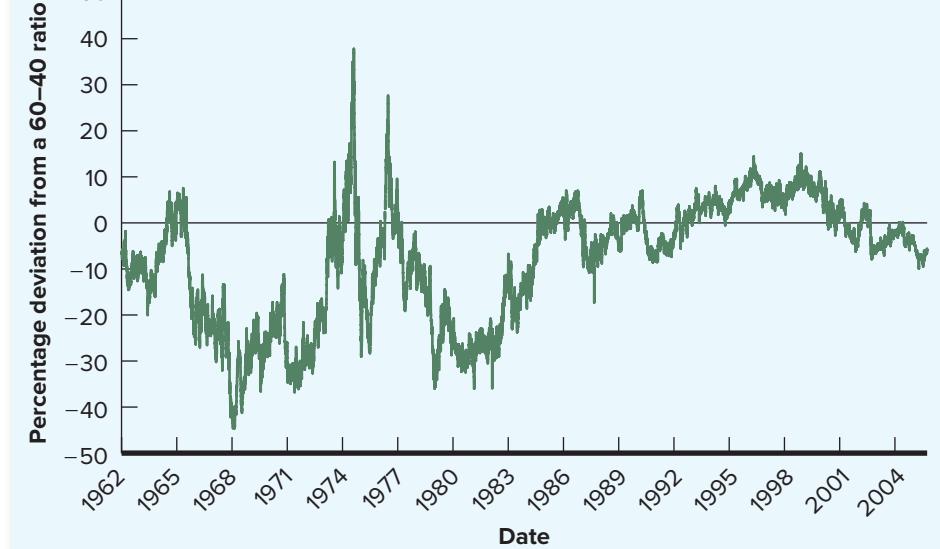
What happened? As you can see in Figure 22.1, the market valued 3Com and Palm shares in such a way that the non-Palm part of 3Com had a negative value for about two months, from March 2, 2000, until May 8, 2000. Even then, it took approval by the IRS for 3Com to proceed with the planned distribution of Palm shares before the non-Palm part of 3Com once again had a positive value.

The Royal Dutch/Shell Price Ratio Another fairly well-known example of an apparent mispricing involves two large oil companies. In 1907, Royal Dutch of the Netherlands and Shell of the U.K. agreed to merge their business enterprises and split operating profits on a 60–40 basis. So, whenever the stock prices of Royal Dutch and Shell were not in a 60–40 ratio, there was a potential opportunity to make an arbitrage profit.

Figure 22.2 contains a plot of the daily deviations from the 60–40 ratio of the Royal Dutch price to the Shell price. If the prices of Royal Dutch and Shell are in a 60–40 ratio, there is a zero percentage deviation. If the price of Royal Dutch is too high compared to the Shell price, there is a positive deviation. If the price of Royal Dutch is too low compared to the price of Shell, there is a negative deviation. As you can see in Figure 22.2, there have been large and persistent deviations from the 60–40 ratio. In fact, the ratio is seldom at 60–40 for most of the time from 1962 through mid-2005 (when the companies merged).

FIGURE 22.2

Royal Dutch and Shell
60–40 Price Ratio
Deviations, 1962 to
2005



BUBBLES AND CRASHES

To paraphrase a famous song, history has shown, over and again, the many follies of men. Nowhere is this statement seemingly more appropriate in finance than in a discussion of bubbles and crashes.

bubble

A situation where observed prices soar far higher than fundamentals and rational analysis would suggest.

crash

A situation where market prices collapse significantly and suddenly.

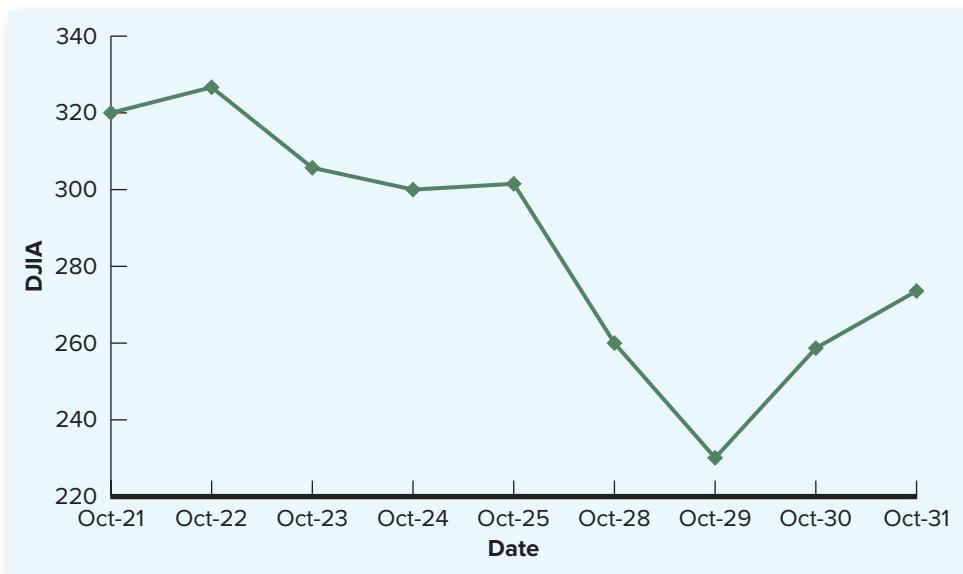
A **bubble** occurs when market prices soar far in excess of what normal and rational analysis would suggest. Investment bubbles eventually pop because they are not based on fundamental values. When a bubble does pop, investors find themselves holding assets with plummeting values.

A **crash** is a significant and sudden drop in marketwide values. Crashes are generally associated with a bubble. Typically, a bubble lasts much longer than a crash. A bubble can form over weeks, months, or even years. Crashes, on the other hand, are sudden, generally lasting less than a week. However, the disastrous financial aftermath of a crash can last for years.

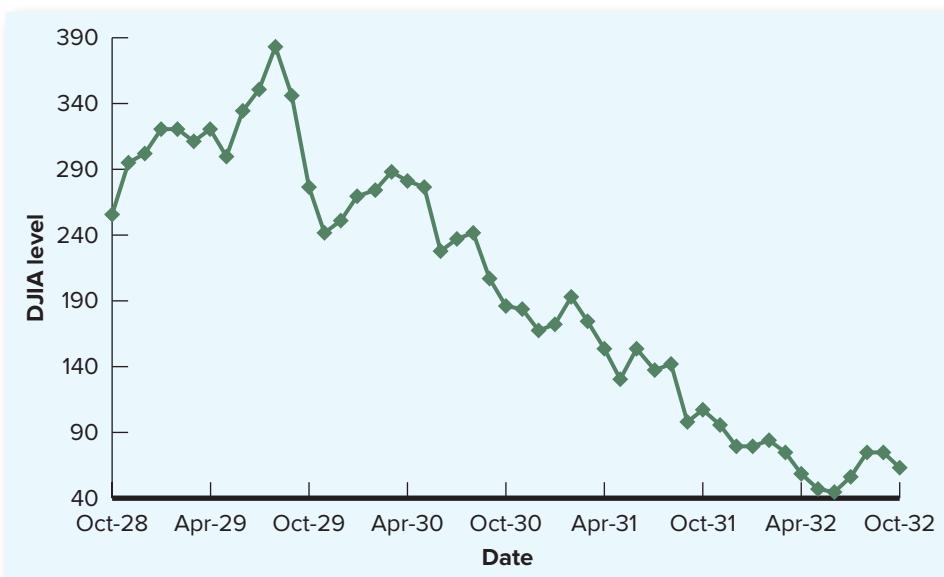
The Crash of 1929 During the Roaring Twenties, the stock market was supposed to be the place where everyone could get rich. The market was widely believed to be a no-risk situation. Many people invested their life savings without learning about the potential pitfalls of investing. At the time, investors could purchase stocks by putting up 10 percent of the purchase price and borrowing the remainder from a broker. This level of leverage was one factor that led to the sudden market downdraft in October 1929.

As you can see in Figure 22.3, on Friday, October 25, the Dow Jones Industrial Average closed up about a point, at 301.22. On Monday, October 28, it closed at 260.64, down 13.5 percent. On Tuesday, October 29, the Dow closed at 230.07, with an intraday low of 212.33, which was about 30 percent lower than the closing level on the previous Friday. On this day, known as “Black Tuesday,” NYSE volume of 16.4 million shares was more than four times normal levels.

Although the Crash of 1929 was a large decline, it pales with respect to the ensuing bear market. As shown in Figure 22.4, the DJIA rebounded about 20 percent following the October 1929 crash. However, the DJIA then began a protracted fall, reaching the bottom at 40.56 on July 8, 1932. This level represents about a 90 percent decline from the record high

**FIGURE 22.3**

Dow Jones Industrial Average, October 21, 1929, to October 31, 1929

**FIGURE 22.4**

Dow Jones Industrial Average, October 1928 to October 1932

level of 386.10 on September 3, 1929. By the way, the DJIA did not surpass its previous high level until November 24, 1954, more than 25 years later.

The Crash of October 1987 Once, when we spoke of *the Crash*, we meant October 29, 1929. That was until October 1987. The Crash of 1987 began on Friday, October 16. On huge volume (at the time) of about 338 million shares, the DJIA fell 108 points to close at 2,246.73. It was the first time in history that the DJIA fell by more than 100 points in one day.

October 19, 1987, now wears the mantle of “Black Monday,” and this day was indeed a dark and stormy one on Wall Street; the market lost about 22.6 percent of its value on a new record volume of about 600 million shares traded. The DJIA plummeted 508.32 points to close at 1,738.74.

FIGURE 22.5

Dow Jones Industrial Average, October 1986 to October 1990



During the day on Tuesday, October 20, the DJIA continued to plunge in value, reaching an intraday low of 1,616.21. But the market rallied and closed at 1,841.01, up 102 points. From the then market high on August 25, 1987, of 2,746.65 to the intraday low on October 20, 1987, the market had fallen over 40 percent.

After the Crash of 1987 there was no protracted depression. In fact, as you can see in Figure 22.5, the DJIA took only two years to surpass its previous market high made in August 1987.

What happened? It's not exactly ancient history, but, here again, debate rages. One faction says that irrational investors had bid up stock prices to ridiculous levels until Black Monday, when the bubble burst, leading to panic selling as investors dumped their stocks. The other faction says that before Black Monday, markets were volatile, volume was heavy, and some ominous signs about the economy were filtering in. From the close on October 13 to the close on October 16, 1987, the market fell by over 10 percent, the largest three-day drop since May 1940 (when German troops broke through French lines near the start of World War II). To top it all off, market values had risen sharply because of a dramatic increase in takeover activity, but Congress was in session and was actively considering antitakeover legislation.

Another factor is that beginning a few years before the Crash of 1987, large investors had developed techniques known as *program trading* designed for very rapid selling of enormous quantities of shares of stock following a market decline. These techniques were still largely untested because the market had been strong for years. Following the huge sell-off on October 16, 1987, sell orders came pouring in on Monday at a pace never before seen. In fact, these program trades were (and are) blamed by some for much of what happened.

One of the few things we know for certain about the Crash of 1987 is that the stock exchanges suffered a meltdown. The NYSE could not handle the volume. Posting of prices was delayed by hours, so investors had no idea what their positions were worth. The specialists couldn't handle the flow of orders, and some specialists actually began selling. NASDAQ went off-line when it became impossible to get through to market makers.

On the two days following the crash, prices *rose* by about 14 percent, one of the biggest short-term gains ever. Prices remained volatile for some time, but as antitakeover talk in Congress died down, the market recovered.

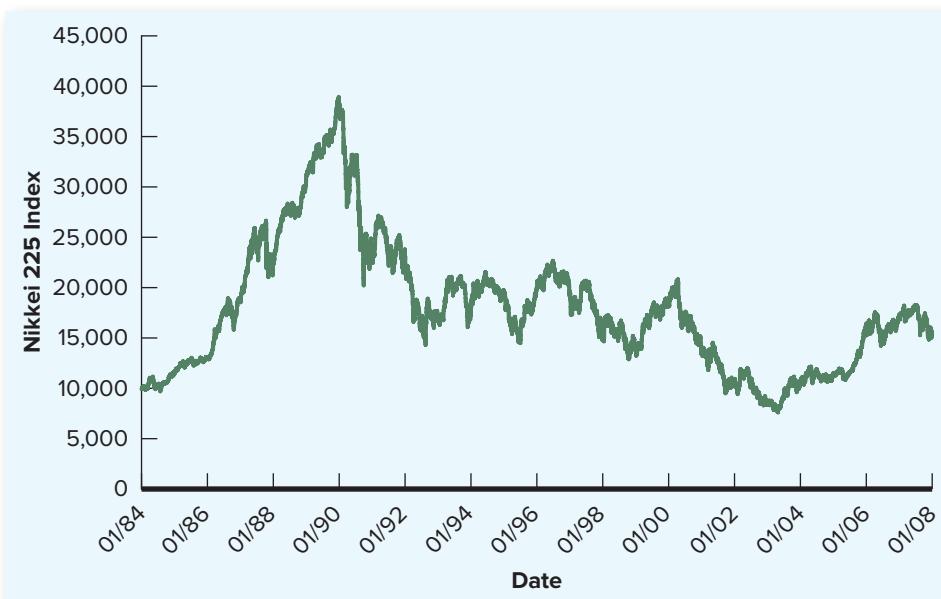


FIGURE 22.6
Nikkei 225 Index,
January 1984 to
December 2007

The Nikkei Crash The crash of the Nikkei Index, which began in 1990, lengthened into a particularly long bear market. It is quite like the Crash of 1929 in that respect.

The Asian crash started with a booming bull market in the 1980s. Japan and emerging Asian economies seemed to be forming a powerful economic force. The “Asian economy” became an investor outlet for those wary of the U.S. market after the Crash of 1987.

To give you some idea of the bubble that was forming in Japan between 1985 and 1989, real estate prices in Japan increased by 70 times, and stock prices increased 100 times over. In 1989, price-earnings ratios of Japanese stocks climbed to unheard-of levels as the Nikkei Index soared past 39,000. In retrospect, there were numerous warning signals about the Japanese market. At the time, however, optimism about the continued growth in the Japanese market remained high. Crashes never seem to occur when the outlook is poor, so, as with other crashes, many people did not foresee the impending Nikkei crash.

As you can see in Figure 22.6, in three years from December 1986 to the peak in December 1989, the Nikkei 225 Index rose 115 percent. Over the next three years, the index lost 57 percent of its value. In early 2018, the Nikkei Index stood at a level that was about 60 percent off its peak in December 1989.

The “Dot-Com” Bubble and Crash How many websites do you think existed at the end of 1994? Would you believe only about 10,000? By the end of 1999, the number of active websites stood at about 9.5 million, and by early 2018, there were about 1.3 billion active websites.

By the mid-1990s, the rise in Internet use and its international growth potential fueled widespread excitement over the “new economy.” Investors did not seem to care about solid business plans—only big ideas. Investor euphoria led to a surge in Internet IPOs, which were commonly referred to as “dot-coms” because so many of their names ended in “.com”. Of course, the lack of solid business models doomed many of the newly formed companies. Many of them suffered huge losses, and some folded relatively shortly after their IPOs.

The extent of the dot-com bubble and subsequent crash is presented in Table 22.1 and Figure 22.7, which compare the Amex Internet Index and the S&P 500 index. As shown

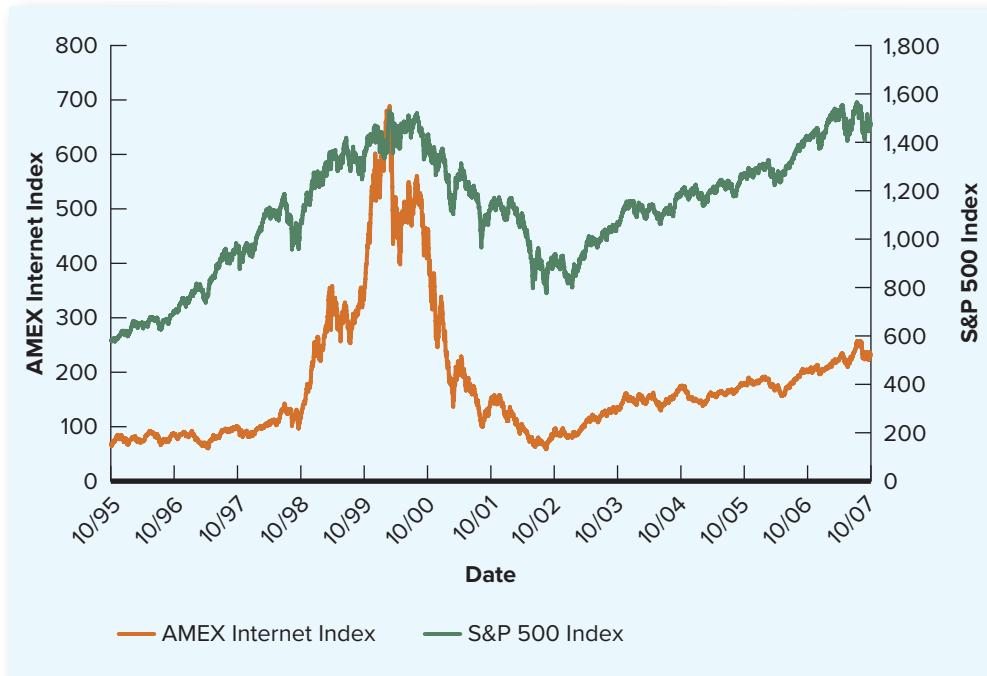


The growth of the World Wide Web is documented at www.zakon.org/robert/internet/timeline.

TABLE 22.1 Values of the Amex Internet Index and the S&P 500 Index

Date	Amex Internet Index Value	Gain to Peak from Oct. 1, 1998 (%)	Loss from Peak to Trough (%)	S&P 500 Index Value	Gain to Peak from Oct. 1, 1998 (%)	Loss from Peak to Trough (%)
October 1, 1998	114.68			986.39		
Late March 2000 (Internet index peak)	688.52	500%		1,293.72	31%	
Early October 2002 (Internet index trough)	58.59		-91%	776.76		-40%

SOURCE: Author calculations.

FIGURE 22.7 Values of the AMEX Internet Index and the S&P 500 Index, October 1995 through October 2007

in Table 22.1, the Amex Internet Index soared from a level of 114.68 on October 1, 1998, to its peak of 688.52 in late March 2000, an increase of 500 percent. The Amex Internet Index then fell to a level of 58.59 in early October 2002, a drop of 91 percent. By contrast, the S&P 500 index rallied about 31 percent in the same 1998–2000 time period and fell 40 percent during the 2000–2002 time period.

By now, you're probably wondering how anyone could sensibly think that financial markets are in any way efficient. Before you make up your mind, be sure to carefully read our next section. As you will see, there is a powerful argument in favor of market efficiency.

Concept Questions

22.5a What is meant by the term *limits to arbitrage*?

22.5b What is noise trader risk?

Market Efficiency and the Performance of Professional Money Managers

22.6

You probably know what a mutual fund is. Investors pool their money and pay a professional to manage the portfolio. There are many types of mutual funds. We will focus here on funds that only buy stocks, and we will refer to such funds as *general equity funds* (GEFs). There are thousands of GEFs in the United States, and the performance of these professionally managed funds has been extensively studied.

Most GEFs are actively managed, meaning that the fund manager actively buys and sells stocks in an attempt to improve the fund's performance. However, one type of mutual fund, known as an *index fund*, is passively managed. Such funds try to replicate the performance of stock market indexes, so there is no trading (unless the index changes, which happens from time to time). The most common type of index fund mimics the S&P 500 index, which we studied in Chapter 12. The Vanguard 500 Index Fund is a well-known example. As of early 2018, this fund was one of the largest mutual funds in the United States, with about \$400 billion in assets.

If markets are inefficient because investors behave irrationally, then stock prices will deviate from their zero-NPV levels, and it should be possible to devise profitable trading strategies to take advantage of these mispricings. As a result, professional money managers in actively managed mutual funds should be able to systematically outperform index funds. In fact, that is what money managers are paid large sums to do.

The number of GEFs has grown substantially during the past 20 years. Figure 22.8 shows the growth in the number of GEFs from 1986 through 2014. The solid green line shows the

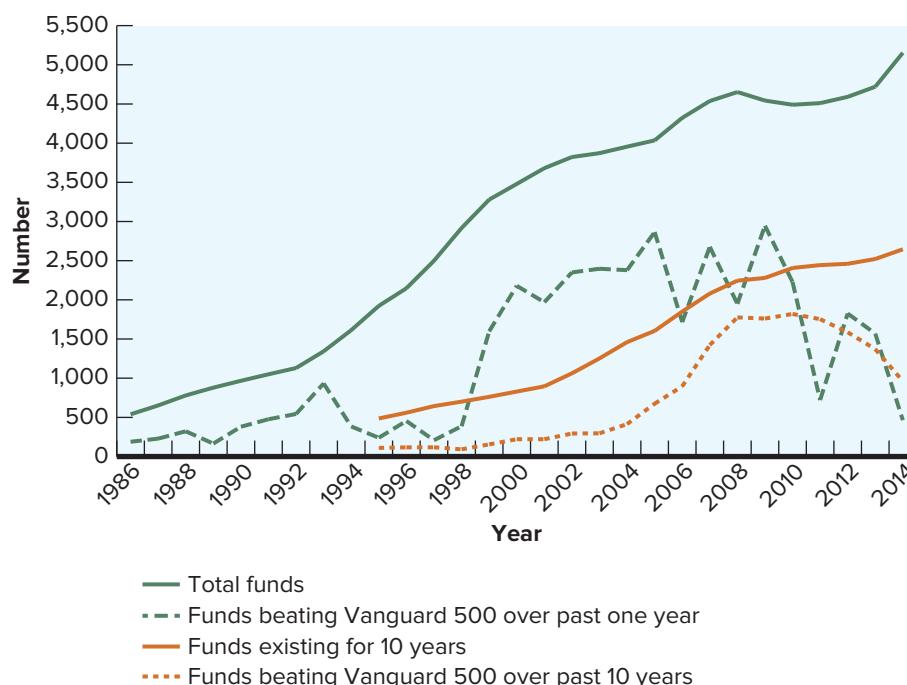


FIGURE 22.8
The Growth of Actively Managed Equity Funds, 1986–2014

SOURCE: Author calculations.

IN THEIR OWN WORDS ...

Hersh Shefrin on Behavioral Finance

Most of the chief financial officers (CFOs) I know admit that there is a gap between what they learned about corporate finance in business schools and what they put into practice as executives. A major reason for this gap is the material you are studying in this chapter.

It really is true that financial managers do not practice textbook corporate finance. In the 1990s, I became convinced that this was the case after I joined the organization Financial Executives International (FEI), which gave me an opportunity to meet many CFOs on a regular basis and discuss with them how they practice corporate finance. In doing so, I gained a great deal of information that led me to conclude that behavioral finance was highly applicable to corporate life.

Behavioral corporate finance is important for at least three reasons. First, being human, financial managers are susceptible to the behavioral phenomena you are reading about in this chapter. Textbook corporate finance offers many valuable concepts, tools, and techniques. My point is not that the material in traditional corporate finance textbooks lacks value, but that psychological obstacles often stand in the way of this material being implemented correctly. Behavioral costs can be very expensive. For example, I would argue that psychological pitfalls were central to the financial decisions that led to the global financial crisis that erupted in 2008. I would also argue that psychological pitfalls were central to the decisions that led to the worst environmental disaster in U.S. history, associated with the explosion of BP's well, Deepwater Horizon, in the Gulf of Mexico during 2010.

Second, the people with whom financial managers interact are also susceptible to mistakes. Expecting other people to be immune to mistakes is itself an error that can lead managers to make bad decisions.

Third, investors' mistakes can sometimes lead prices to be inefficient. In this respect, managers can make one of two different mistakes. They might believe that prices are efficient when they are actually inefficient. Or they might believe that prices are inefficient when they are actually efficient. Managers need to know how to think about the vulnerability to both types of errors, and how to deal with each.

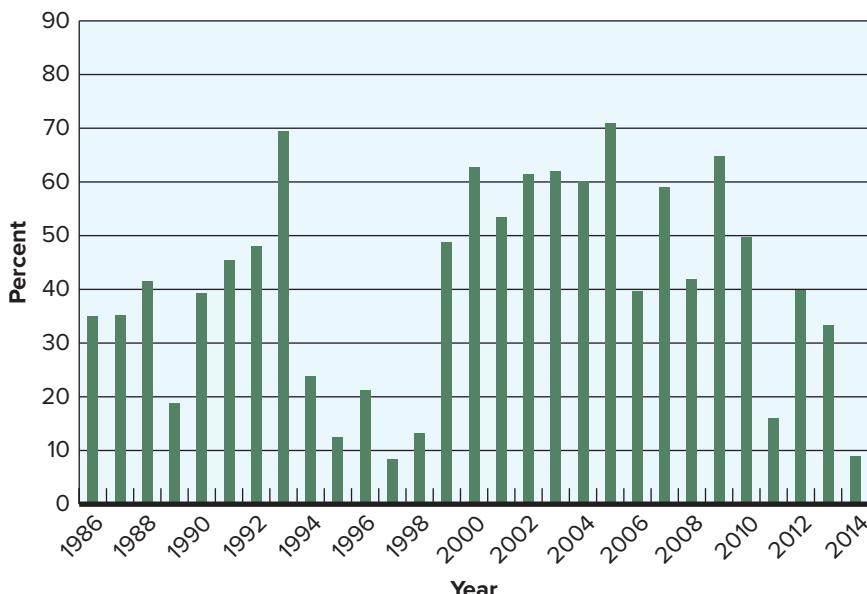
The material in this chapter is a wonderful start to learning about behavioral finance. However, for this material to really make a difference, you need to integrate the material with what you are learning about traditional topics such as capital budgeting, capital structure, valuation, payout policy, market efficiency, corporate governance, and mergers and acquisition. You need to study behavioral cases about real people making real decisions and see how psychology impacts those decisions. You need to learn from their mistakes in an effort to make better decisions yourself. This is how behavioral corporate finance will generate value for you.

Hersh Shefrin holds the Mario L. Belotti Chair at the Leavey School of Business at Santa Clara University and is the author of Behavioral Corporate Finance: Decisions that Create Value.

total number of funds that have existed for at least 1 year, while the solid orange line shows the number of funds that have existed for at least 10 years. From Figure 22.8, you can see that it is difficult for professional money managers to keep their funds in existence for 10 years (if it were easy, there would not be much difference between the solid green line and the solid orange line).

Figure 22.8 also shows the number of these funds that beat the performance of the Vanguard 500 Index Fund. You can see that there is much more variation in the dashed green line than in the dashed orange line. What this means is that in any given year, it is hard to predict how many professional money managers will beat the Vanguard 500 Index Fund. But the low level and low variation of the dashed orange line means that the percentage of professional money managers who can beat the Vanguard 500 Index Fund over a 10-year investment period is low and stable.

Figures 22.9 and 22.10 are bar charts that show the percentage of managed equity funds that beat the Vanguard 500 Index Fund. Figure 22.9 uses return data for the previous year only, while Figure 22.10 uses return data for the previous 10 years. As you can see from Figure 22.9, in only 9 of the 29 years spanning 1986 through 2014 did more than half the professional money managers beat the Vanguard 500 Index Fund. The performance is worse when it comes to 10-year investment periods (1986–1995 through 2005–2014). As shown in Figure 22.10, in only 7 of these 17 investment periods did more than half the professional money managers beat the Vanguard 500 Index Fund.



SOURCE: Author calculations.

FIGURE 22.9

Percentage of
Managed Equity Funds
Beating the Vanguard
500 Index Fund,
One-Year Returns

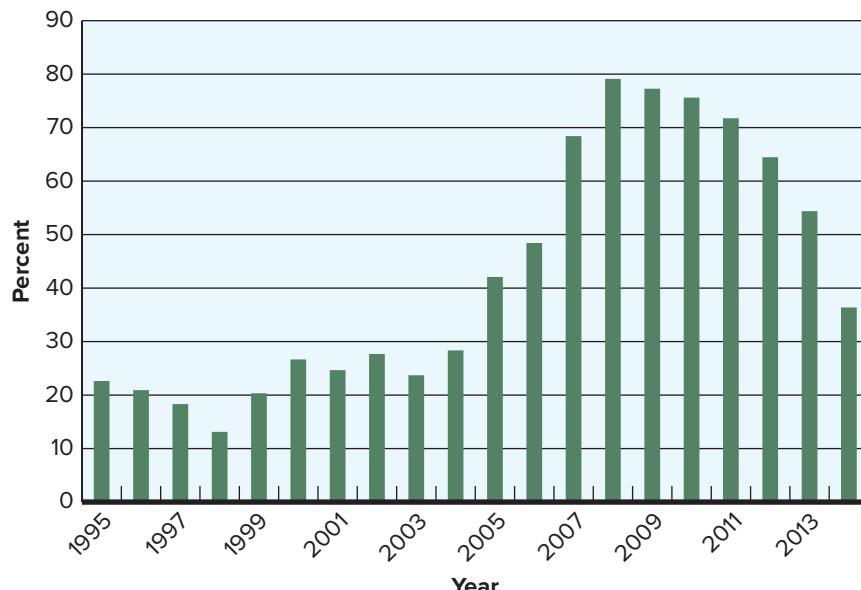


FIGURE 22.10

Percentage of
Managed Equity Funds
Beating the Vanguard
500 Index Fund,
10-Year Returns

SOURCE: Author calculations.

Table 22.2 presents more evidence concerning the performance of professional money managers. Using data from 1980 through 2014, we divide this time period into 1-year investment periods, rolling 3-year investment periods, rolling 5-year investment periods, and rolling 10-year investment periods. Then, after we calculate the number of investment periods, we ask two questions: (1) What percentage of the time did half the professionally managed funds beat the Vanguard 500 Index Fund? and (2) What percentage of the time did three-fourths of the professionally managed funds beat the Vanguard 500 Index Fund?

TABLE 22.2 The Performance of Professional Money Managers versus the Vanguard 500 Index Fund

Length of Each Investment Period (Years)	Span	Number of Investment Periods	Number of Investment Periods Half the Funds Beat Vanguard	Percent	Number of Investment Periods Three-Fourths of the Funds Beat Vanguard	Percent
1	1986–2014	29	9	31.0%	0	0.0%
3	1988–2014	27	11	40.7	0	0.0
5	1990–2014	25	10	40.0	1	4.0
10	1995–2014	20	7	35.0	3	15.0

SOURCE: Author calculations.

As you see in Table 22.2, the performance of professional money managers is generally quite poor relative to the Vanguard 500 Index Fund. In addition, the performance of professional money managers declines the longer the investment period.

The figures and table in this section raise some difficult and uncomfortable questions for security analysts and other investment professionals. If markets are inefficient, and tools like fundamental analysis are valuable, why don't mutual fund managers do better? Why can't mutual fund managers even beat a broad market index?

The performance of professional money managers is especially troublesome when we consider the enormous resources at their disposal and the substantial survivorship bias that exists. The survivorship bias comes into being because managers and funds that do especially poorly disappear. If beating the market were possible, then this Darwinian process of elimination should lead to a situation in which the survivors, as a group, are capable of doing so. The fact that professional money managers seem to lack the ability to outperform a broad market index is consistent with the notion that, overall, the equity market is efficient.

So where does our discussion of behavioral finance and market efficiency leave us? Are the major financial markets efficient? Based on the past 40 or so years of research, we can make an observation or two. We start by noting that the relevant question isn't, "Are markets efficient?" Instead, it's "How efficient are markets?" It seems clear that markets are not perfectly efficient, and barriers to arbitrage do exist. On the other hand, the inability of professional money managers to consistently outperform simple market indexes strongly suggests that the major markets operate with a relatively high degree of efficiency.

Concept Questions

- 22.6a** How does an index fund differ from an actively managed mutual fund?
- 22.6b** What do we learn from studying the historical performance of actively managed general equity funds?

22.7 Summary and Conclusions

In this chapter, we examined some of the implications of research in cognitive psychology and behavioral finance. In the first part of the chapter, we learned that a key to becoming a better financial decision maker is to be aware of, and avoid, certain types of behaviors. By studying behavioral finance, you can see the potential damage from errors due to biases, frame dependence, and heuristics.

Biases can lead to bad decisions because they lead to unnecessarily poor estimates of future outcomes. Overoptimism, for example, leads to overly favorable estimates and opinions. Frame dependence leads to narrow framing, which is focusing on the smaller picture instead of the bigger one. The use of heuristics as shortcuts ignores potentially valuable insights that more detailed analysis would reveal.

In the second part of the chapter, we turned to a much more difficult question, and one where the evidence is not at all clear. Do errors in judgment by investors influence market prices and lead to market inefficiencies? This question is the subject of raging debate among researchers and practitioners, and we are not going to take sides. Instead, our goal is to introduce you to the ideas and issues.

We saw that market inefficiencies can be difficult for arbitrageurs to exploit because of firm-specific risk, noise trader (or sentiment-based) risk, and implementation costs. We called these difficulties *limits to arbitrage*, and the implication is that some inefficiencies may only gradually disappear, and smaller inefficiencies can persist if they cannot be profitably exploited.

Looking back at market history, we saw some examples of evident mispricing, such as the Palm IPO. We also saw that markets appear to be susceptible to bubbles and crashes, suggesting significant inefficiency. However, our examination of the performance of professional money managers revealed clear and striking evidence to the contrary. The pros can't consistently outperform broad market indexes, which is strong evidence in favor of market efficiency.

CONNECT TO FINANCE



connect[®]

If you are using *Connect Finance* in your course, get online to take a Practice Test, check out study tools, and find out where you need additional practice.

Can you answer the following Connect Quiz questions?

Section 22.1 Cognitive errors are best explained as errors in _____.

Section 22.2 Darren is the type of manager who is constantly looking for affirmation that his decisions are correct. Darren most likely suffers most from which bias?

Section 22.5 The Asian crisis caused the Japanese market, as measured by the Nikkei Index, to lose approximately what percentage of its value?

CONCEPTS REVIEW AND CRITICAL THINKING QUESTIONS

- Limits to Arbitrage [LO4]** In the chapter, we discussed the 3Com/Palm and Royal Dutch/Shell mispricings. Which of the limits to arbitrage would least likely be the main reason for these mispricings? Explain.
- Overconfidence [LO1]** How could overconfidence affect the financial manager of the firm and the firm's shareholders?
- Frame Dependence [LO2]** How can frame dependence lead to irrational investment decisions?
- Noise Trader Risk [LO4]** What is noise trader risk? How can noise trader risk lead to market inefficiencies?
- Probabilities [LO3]** Suppose you are flipping a fair coin in a coin-flipping contest and have flipped eight heads in a row. What is the probability of flipping a head on

your next coin flip? Suppose you flipped a head on your ninth toss. What is the probability of flipping a head on your tenth toss?

6. **Performance of the Pros [LO4]** In the mid- to late-1990s, the performance of the pros was unusually poor—on the order of 90 percent of all equity mutual funds underperformed a passively managed index fund. How does this fact bear on the issue of market efficiency?
7. **Efficient Markets Hypothesis [LO4]** The efficient markets hypothesis implies that all mutual funds should obtain the same expected risk-adjusted returns. Therefore, we can pick mutual funds at random. Is this statement true or false? Explain.
8. **Evidence on Market Efficiency [LO4]** Some people argue that the efficient markets hypothesis cannot explain the 1987 market crash or the high price-to-earnings ratio of Internet stocks during the late 1990s. What alternative hypothesis is currently used for these two phenomena?
9. **Behavioral Finance and Efficient Markets [LO4]** Proponents of behavioral finance use three concepts to argue that markets are not efficient. What are these arguments?
10. **Frame Dependence [LO2]** In the chapter, we presented an example where you have lost \$78 and are given the opportunity to make a wager in which you have an 80 percent chance that your loss will increase to \$100 and a 20 percent chance that your loss will decrease to \$0. Using the stand-alone principle from capital budgeting, explain how your decision to accept or reject the proposal could have been affected by frame dependence. In other words, reframe the question in a way in which most people are likely to analyze the proposal correctly.

MINICASE

Your 401(k) Account at S&S Air

You have been at your job with S&S Air for a week now and have decided you need to sign up for the company's 401(k) plan. Even after your discussion with Audrey Sanborn, the Bledsoe Financial Services representative, you are still unsure as to which investment option you should choose. Recall that the options available to you are stock in S&S Air, the Bledsoe S&P 500 Index Fund, the Bledsoe Small-Cap Fund, the Bledsoe Large-Company Stock Fund, the Bledsoe Bond Fund, and the Bledsoe Money Market Fund. You have decided that you should invest in a diversified portfolio, with 70 percent of your investment in equities, 25 percent in bonds, and 5 percent in the money market fund.

You have also decided to focus your equity investment on large-cap stocks, but you are debating whether to select the S&P 500 Index Fund or the Large-Company Stock Fund. In thinking it over, you understand the basic difference in the two funds. One is a purely passive fund that replicates a widely followed large-cap index, the S&P 500, and has low fees. The other is actively managed with the intention that the skill of the portfolio manager will result in improved performance relative to an index. Fees are higher in the latter fund. You're just not

certain which way to go, so you ask Chris Guthrie, who works in the company's finance area, for advice.

After discussing your concerns, Chris gives you some information comparing the performance of equity mutual funds and the Vanguard 500 Index Fund. The Vanguard 500 is the world's largest equity index mutual fund. It replicates the S&P 500, and its return is only negligibly different from the S&P 500. Fees are very low. As a result, the Vanguard 500 is essentially identical to the Bledsoe S&P 500 Index Fund offered in the 401(k) plan, but it has been in existence for much longer, so you can study its track record for over two decades. Chris suggests that you study Figure 22.10 and answer the following questions.

QUESTIONS

1. What implications do you draw from the graph for mutual fund investors?
2. Is the graph consistent or inconsistent with market efficiency? Explain carefully.
3. What investment decision would you make for the equity portion of your 401(k) account? Why?

Enterprise Risk Management

23

Chapter

NATURAL DISASTERS ARE A MAJOR RISK for property and casualty insurance companies. For example, the 2011 tsunami in Japan was estimated to have cost \$235 billion, and Hurricane Katrina caused over \$80 billion in damages in 2005. So how do insurance and reinsurance companies handle this risk? One way is to use catastrophe, or “cat,” bonds. With a cat bond, the issuer pays the coupon like any other bond; however, if a “trigger” is hit, the issuer does not have to repay the principal. During 2017, companies issued a little more than \$12.5 billion in cat bonds, the largest amount issued during a single year. By the end of 2017, a total of \$29.6 billion worth of cat bonds was outstanding. As we will see in this chapter, there are a variety of sophisticated financial tools available to deal with risks, including futures, options, and swaps.

Learning Objectives

After studying this chapter, you should be able to:

- L01** Outline the exposures to risk in a company’s business and how a company could choose to hedge these risks.
- L02** Describe the similarities and differences between futures and forward contracts and how these contracts are used to hedge risk.
- L03** Define the basics of swap contracts and how they are used to hedge interest rates.
- L04** Explain the payoffs of option contracts and how they are used to hedge risk.

© by iStockphoto/Getty Images

For updates on the latest happenings in finance, visit fundamentalsofcorporatefinance.blogspot.com.

All businesses face risks of many types. Some, such as unexpected cost increases, may be obvious, while others, such as disasters caused by human error, are not. **Enterprise risk management (ERM)** is the process of identifying and assessing risks and, where financially sensible, seeking to mitigate potential damage. Companies have always taken steps to manage risks. The change in recent years has been to view risk management more as a holistic, integrated exercise rather than as something to be done on a piecewise basis. There is much greater awareness of the variety, complexity, and interactions of risks at the companywide level. In fact, as the benefits from ERM have become increasingly clear, many companies have created a new “c-level” executive position, the chief risk officer (CRO).

Broadly speaking, risks fall into four types. First, *hazard risks* involve damage done by outside forces such as natural disasters, theft, and lawsuits. Second, *financial risks* arise from such things as adverse exchange rate changes, commodity price fluctuations, and

enterprise risk management (ERM)

The process of identifying and assessing risks and seeking to mitigate potential damage.



Check out the International Financial Risk Institute for more on risk management at ifci.ch.

interest rate movements. Third, *operational risks* encompass impairments or disruptions in operations from a wide variety of business-related sources, including human resources; product development, distribution, and marketing; and supply chain management. Finally, *strategic risks* include large-scale issues such as competition, changing customer needs, social and demographic changes, regulatory and political trends, and technological innovation. Another important strategic risk is damage done to a company's reputation as a result of product problems, fraud, or other unfavorable publicity.

One important aspect of ERM is to view risks in the context of the entire company. A risk that damages one division of a company might benefit another such that they more or less offset each other. In this case, mitigating the risk in one division makes the overall company worse off. Consider a vertically integrated oil company in which one division drills for oil and another refines it. An increase in oil prices benefits the driller and harms the refiner, but taken together, there may be little or no overall impact on the company's cash flows. Similarly, for a multinational with operations in many countries, exchange rate fluctuations may have limited impact at the overall company level. Another thing to recognize is that not all risks are worth eliminating. It is important to prioritize and identify risks that have the greatest potential for economic and social harm.

For all firms, risk management begins with prevention. Taking steps to promote things like product safety and accident avoidance is obviously very important, but these issues are likely to be very company-specific and thus hard to discuss in general terms. Prevention also is more of an operating activity than a financial activity. However, certain types of financial instruments are used by companies of all types to manage and mitigate risk, particularly financial and hazard risk, and these will be the primary focus of our chapter.

23.1 Insurance

Insurance is the most widely used risk management tool. It is generally used to protect against hazard risks. Insurance can be used to provide protection against losses due to damage to a firm's property and any associated loss of income. It also protects against liabilities that may arise as a result of interactions with third parties. For example, like individuals, companies will usually carry property insurance to protect against large-scale losses due to hazards ranging from fire to storm damage. Other types of insurance commonly purchased include:

- *Commercial liability insurance:* Protects against costs that can occur because of damages to others caused by the company's products, operations, or employees.
- *Business interruption insurance:* Protects against the loss of earnings if business operations are interrupted by an insured event such as fire or natural disaster.
- *Key personnel insurance:* Protects against losses due to loss of critical employees.
- *Workers' compensation and employer's liability insurance:* Protects against costs a firm is required to pay in connection with work-related injuries sustained by its employees.

It is important that companies and their risk managers fully understand the policy limits, policy conditions, and perils covered by the insurance policies they purchase. Losses due to earthquakes, flooding, and terrorism are typically excluded from standard commercial property policies. Firms wishing coverage for these perils must make special arrangements with their insurers. Firms must also abide by policy conditions; for instance, policies often require the insurer to be notified of any loss in a timely manner. A risk manager does not

want to become familiar with a firm's insurance policy exclusions after a loss occurs. Whether to purchase insurance is, at least in principle, a straightforward NPV question. The insurance premium is the cost. The benefit is the present value of the expected payout by the insurance company to the firm. Imagine a firm has a key production facility. There is a small chance, say 1-in-10,000 (or .01 percent) that the facility will be destroyed by fire or natural disaster in the next year. The cost to the firm to rebuild plus any lost profits would be \$200 million if that occurs. Thus, the firm either loses \$0 or \$200 million. Its expected loss is:

$$\text{Expected loss} = (.9999 \times \$0) + (.0001 \times \$200 \text{ million}) = \$20,000$$

Of course, if the firm could eliminate the possibility of loss for the present value of \$20,000 (or less), it would do so. But assuming that the cost of completely eliminating the risk (if that is even technologically possible) is greater than the present value of \$20,000, then the firm can purchase insurance.

The firm's decision to purchase insurance, or what types of insurance a firm decides to purchase, depends on the nature of the firm's business, the size of the firm, and the firm's risk aversion, as well as legal and third-party requirements that may demand proof of insurance. Large firms will often forgo insurance against less costly events, opting to "self-insure." When looking across all of the smaller risks faced by a big firm, it can be less expensive to sustain a certain loss rate than to pay the insurance premiums. Alternatively, firms may opt to purchase insurance with large deductibles, meaning the firm will cover losses up to some level before the insurance kicks in. This approach protects the firm from truly catastrophic losses.

Concept Questions

- 23.1a** What are some basic types of insurance purchased by companies?
- 23.1b** What does it mean for a company to self-insure?

Managing Financial Risk

Purchasing insurance is one way to manage risk, particularly hazard risks. Managing financial risks is often handled by firms without the assistance of insurance companies. In the remainder of this chapter, we discuss ways firms reduce their exposure to price and rate fluctuations, a process known as **hedging**. The term *immunization* is sometimes used as well. As we will discuss, there are many different types of hedging and many different techniques. Frequently, when a firm desires to hedge a particular risk, there will be no direct way of doing so. The financial manager's job in such cases is to create a way by using available financial instruments to create new ones. This process has come to be called *financial engineering*.

Financial risk management often involves the buying and selling of **derivative securities**. A derivative security is a financial asset that represents a claim to another asset. For example, a stock option gives the owner the right to buy or sell stock, a financial asset; so stock options are derivative securities. Financial engineering frequently involves creating new derivative securities, or else combining existing derivatives to accomplish specific hedging goals.

To effectively manage financial risk, financial managers need to identify the types of price fluctuations that have the greatest impact on the value of the firm. Sometimes these will be obvious, but other times they will not. Consider a forest products company. If

23.2

hedging

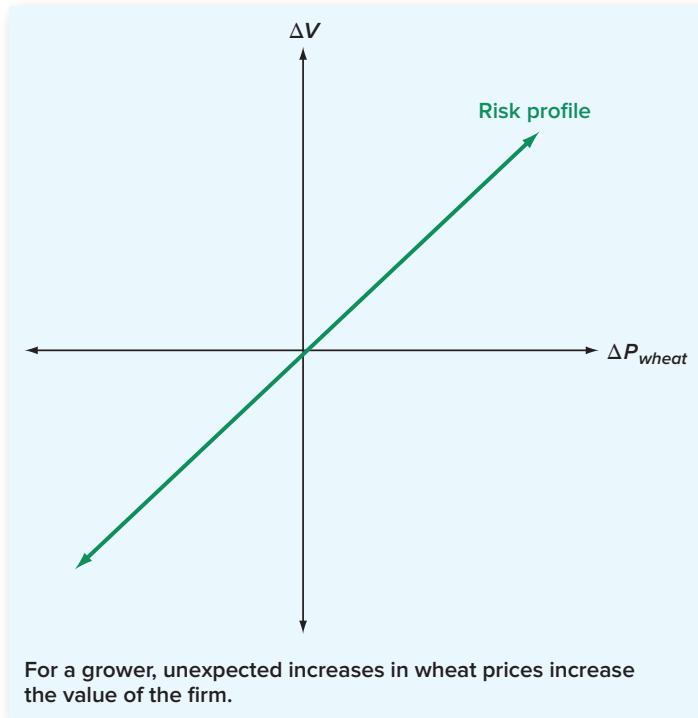
Reducing a firm's exposure to price or rate fluctuations. Also called *immunization*.

derivative security

A financial asset that represents a claim to another financial asset.

FIGURE 23.1

Risk Profile for a Wheat Grower



interest rates increase, then its borrowing costs will clearly rise. Beyond this, however, the demand for housing typically declines as interest rates rise. As housing demand falls, so does demand for lumber. An increase in interest rates thus leads to increased financing costs and, at the same time, decreased revenues.

THE RISK PROFILE

risk profile

A plot showing how the value of the firm is affected by changes in prices or rates.

The basic tool for identifying and measuring a firm's exposure to financial risk is the **risk profile**. The risk profile is a plot showing the relationship between changes in the price of some good, service, or rate and changes in the value of the firm. Constructing a risk profile is conceptually very similar to performing a sensitivity analysis (described in Chapter 11).

To illustrate, consider an agricultural products company that has a large-scale wheat farming operation. Because wheat prices can be very volatile, we might wish to investigate the firm's exposure to wheat price fluctuations—that is, its risk profile with regard to wheat prices. To do this, we plot changes in the value of the firm (ΔV) versus unexpected changes in wheat prices (ΔP_{wheat}). Figure 23.1 shows the result.

The risk profile in Figure 23.1 tells us two things. First, because the line slopes up, increases in wheat prices will increase the value of the firm. Because wheat is an output, this comes as no surprise. Second, because the line has a fairly steep slope, this firm has a significant exposure to wheat price fluctuations, and it may wish to take steps to reduce that exposure.

REDUCING RISK EXPOSURE

Fluctuations in the price of any particular good or service can have very different effects on different types of firms. Going back to wheat prices, we now consider the case of a food processing operation. The food processor buys large quantities of wheat and has a risk profile like that illustrated in Figure 23.2. As with the agricultural products firm, the value

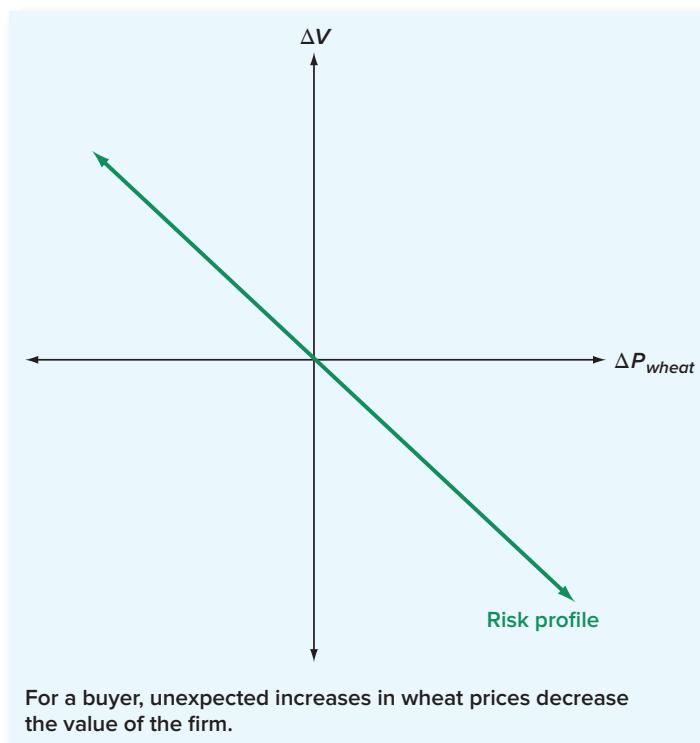


FIGURE 23.2
Risk Profile for a Wheat Buyer

of this firm is sensitive to wheat prices; but because wheat is an input, increases in wheat prices lead to decreases in firm value.

Both the agricultural products firm and the food processor are exposed to wheat price fluctuations, but such fluctuations have opposite effects for the two firms. If these two firms get together, then much of the risk can be eliminated. The grower and the processor can agree that, at set dates in the future, the grower will deliver a certain quantity of wheat, and the processor will pay a set price. Once the agreement is signed, both firms will have locked in the price of wheat for as long as the contract is in effect, and both of their risk profiles with regard to wheat prices will be completely flat during that time.

We should note that, in reality, a firm that hedges financial risk usually won't be able to create a completely flat risk profile. For example, our wheat grower doesn't actually know what the size of the crop will be ahead of time. If the crop is larger than expected, then some portion of the crop will be unhedged. If the crop is small, then the grower will have to buy more to fulfill the contract and will thereby be exposed to the risk of price changes. Either way, there is some exposure to wheat price fluctuations; but hedging sharply reduces that exposure.

There are a number of other reasons why perfect hedging is usually impossible, but this is not really a problem. With most financial risk management, the goal is to reduce the risk to more bearable levels and thereby flatten out the risk profile, not necessarily to eliminate the risk altogether.

In thinking about financial risk, there is an important distinction to be made. Price fluctuations have two components. Short-run, essentially temporary changes are the first component. The second component has to do with more long-run, essentially permanent changes. As we discuss next, these two types of changes have very different implications for the firm.

HEDGING SHORT-RUN EXPOSURE

Short-run, temporary changes in prices result from unforeseen events or shocks. Some examples are sudden increases in orange juice prices because of a late Florida freeze, increases in oil prices because of political turmoil, and increases in lumber prices because available supplies are low following a hurricane. Price fluctuations of this sort are often called *transitory* changes.

Short-run price changes can drive a business into financial distress even though, in the long run, the business is fundamentally sound. This happens when a firm finds itself with sudden cost increases that it cannot pass on to its customers immediately. A negative cash flow position is created, and the firm may be unable to meet its financial obligations.

Wheat crops might be much larger than expected in a particular year because of unusually good growing conditions. At harvest time, wheat prices will be unexpectedly low. By that time, a wheat farmer will have already incurred most of the costs of production. If prices drop too low, revenues from the crop will be insufficient to cover the costs, and financial distress may result.

transactions exposure

Short-run financial risk arising from the need to buy or sell at uncertain prices or rates in the near future.

Short-run financial risk is often called **transactions exposure**. This name stems from the fact that short-term financial exposure typically arises because a firm must make transactions in the near future at uncertain prices or rates. With our wheat farmer the crop must be sold at the end of the harvest, but the wheat price is uncertain. Alternatively, a firm may have a bond issue that will be maturing next year that it will need to replace, but the interest rate that the firm will have to pay is unknown.

As we will see, short-run financial risk can be managed in a variety of ways. The opportunities for short-term hedging have grown tremendously in recent years, and firms in the United States are increasingly hedging away transitory price changes.

CASH FLOW HEDGING: A CAUTIONARY NOTE

One thing to notice is that, in our discussion thus far, we have talked conceptually about hedging the value of the firm. In our example concerning wheat prices, what is really hedged is the firm's near-term cash flow. In fact, at the risk of ignoring some subtleties, we will say that hedging short-term financial exposure, hedging transactions exposure, and hedging near-term cash flows amount to much the same thing.

It will usually be the case that directly hedging the value of the firm is not really feasible; instead, the firm will try to reduce the uncertainty of its near-term cash flows. If the firm is thereby able to avoid expensive disruptions, then cash flow hedging will act to hedge the value of the firm, but the linkage is indirect. In such cases, care must be taken to ensure that the cash flow hedging does have the desired effect.

Imagine a vertically integrated firm with an oil-producing division and a gasoline-retailing division. Both divisions are affected by fluctuations in oil prices. However, it may well be that the firm as a whole has very little transactions exposure because any transitory shifts in oil prices benefit one division and cost the other. The overall firm's risk profile with regard to oil prices is essentially flat. Put another way, the firm's net exposure is small. If one division, acting on its own, were to begin hedging its cash flows, then the firm as a whole would suddenly be exposed to financial risk. The point is that cash flow hedging should not be done in isolation. Instead, a firm needs to worry about its net exposure. As a result, any hedging activities should probably be done on a centralized, or at least cooperative, basis.

HEDGING LONG-TERM EXPOSURE

Price fluctuations can also be longer-run, more permanent changes. These result from fundamental shifts in the underlying economics of a business. If improvements in agricultural

technology come about, then wheat prices will permanently decline (in the absence of agricultural price subsidies!). If a firm is unable to adapt to the new technology, then it will not be economically viable over the long run.

A firm's exposure to long-run financial risks is often called its **economic exposure**. Because long-term exposure is rooted in fundamental economic forces, it is much more difficult, if not impossible, to hedge on a permanent basis. Is it possible that a wheat farmer and a food processor could permanently eliminate exposure to wheat price fluctuations by agreeing on a fixed price forever?

The answer is no; in fact, the effect of such an agreement might even be the opposite of the one desired. The reason is that if, over the long run, wheat prices were to change on a permanent basis, one party to this agreement would ultimately be unable to honor it. Either the buyer would be paying too much, or the seller would be receiving too little. In either case, the loser would become uncompetitive and fail. Something of the sort happened in the 1970s when public utilities and other energy consumers entered into long-run contracts with natural gas producers. Natural gas prices plummeted in later years, and a great deal of turmoil followed.

economic exposure

Long-term financial risk arising from permanent changes in prices or other economic fundamentals.

CONCLUSION

In the long run, either a business is economically viable or it will fail. No amount of hedging can change this simple fact. Nonetheless, by hedging over the near term, a firm gives itself time to adjust its operations and thereby adapt to new conditions without expensive disruptions. So, drawing our discussion in this section together, we can say that, by managing financial risks, the firm can accomplish two important things. The first is that the firm insulates itself from otherwise troublesome transitory price fluctuations. The second is that the firm gives itself a little breathing room to adapt to fundamental changes in market conditions.

Concept Questions

- 23.2a** What is a risk profile? Describe the risk profiles with regard to oil prices for an oil producer and a gasoline retailer.
- 23.2b** What can a firm accomplish by hedging financial risk?

Hedging with Forward Contracts

23.3

Forward contracts are among the oldest and most basic tools for managing financial risk. Our goal in this section is to describe forward contracts and discuss how they are used to hedge financial risk.

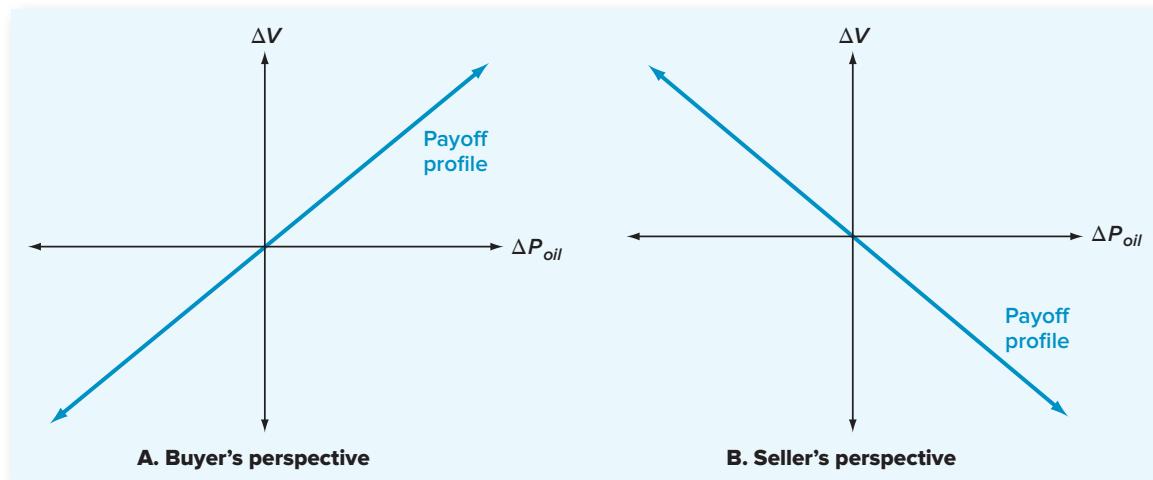
FORWARD CONTRACTS: THE BASICS

A **forward contract** is a legally binding agreement between two parties calling for the sale of an asset or product in the future at a price agreed on today. The terms of the contract call for one party to deliver the goods to the other on a certain date in the future, called the *settlement date*. The other party pays the previously agreed *forward price* and takes the goods. Looking back, note that the agreement we discussed between the wheat grower and the food processor was, in fact, a forward contract.

Forward contracts can be bought and sold. The *buyer* of a forward contract has the obligation to take delivery and pay for the goods; the *seller* has the obligation to make delivery

forward contract

A legally binding agreement between two parties calling for the sale of an asset or product in the future at a price agreed on today.

FIGURE 23.3 Payoff Profiles for a Forward Contract

and accept payment. The buyer of a forward contract benefits if prices increase because the buyer will have locked in a lower price. Similarly, the seller wins if prices fall because a higher selling price has been locked in. Note that one party to a forward contract can win only at the expense of the other, so a forward contract is a zero-sum game.

THE PAYOFF PROFILE

payoff profile

A plot showing the gains and losses that will occur on a contract as the result of unexpected price changes.

The **payoff profile** is the key to understanding how forward contracts (and other contracts we discuss later) are used to hedge financial risks. In general, a payoff profile is a plot showing the gains and losses on a contract that result from unexpected price changes. Suppose we were examining a forward contract on oil. Based on our discussion, the buyer of the forward contract is obligated to accept delivery of a specified quantity of oil at a future date and pay a set price. Part A of Figure 23.3 shows the resulting payoff profile on the forward contract from the buyer's perspective.

What Part A of Figure 23.3 shows is that, as oil prices increase, the buyer of the forward contract benefits by having locked in a lower-than-market price. If oil prices decrease, then the buyer loses because that buyer ends up paying a higher-than-market price. For the seller of the forward contract, things are reversed. The payoff profile of the seller is illustrated in Part B of Figure 23.3.

HEDGING WITH FORWARDS

To illustrate how forward contracts can be used to hedge, we consider the case of a public utility that uses oil to generate power. The prices that our utility can charge are regulated and cannot be changed rapidly. As a result, sudden increases in oil prices are a source of financial risk.¹ The utility's risk profile is illustrated in Figure 23.4.

If we compare the risk profile in Figure 23.4 to the buyer's payoff profile on a forward contract shown in Part A of Figure 23.3, we see what the utility needs to do. The payoff profile for the buyer of a forward contract on oil is exactly the opposite of the utility's risk profile with respect to oil. If the utility buys a forward contract, its exposure to unexpected changes in oil prices will be eliminated. This result is shown in Figure 23.5.

¹Actually, many utilities are allowed to automatically pass on oil price increases.

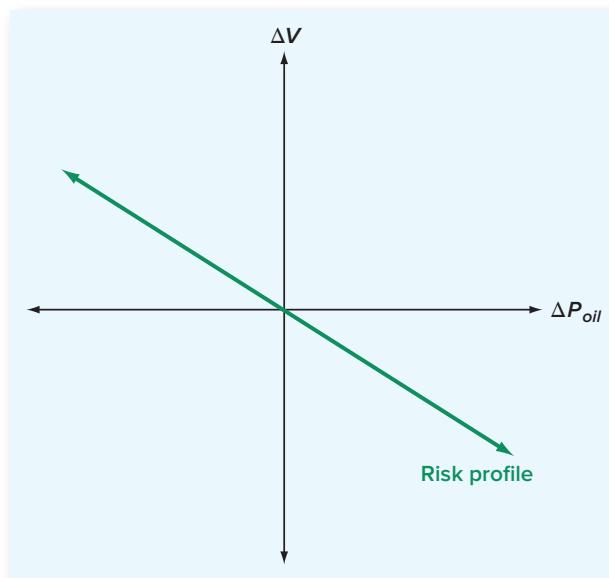


FIGURE 23.4
Risk Profile for an Oil
Buyer

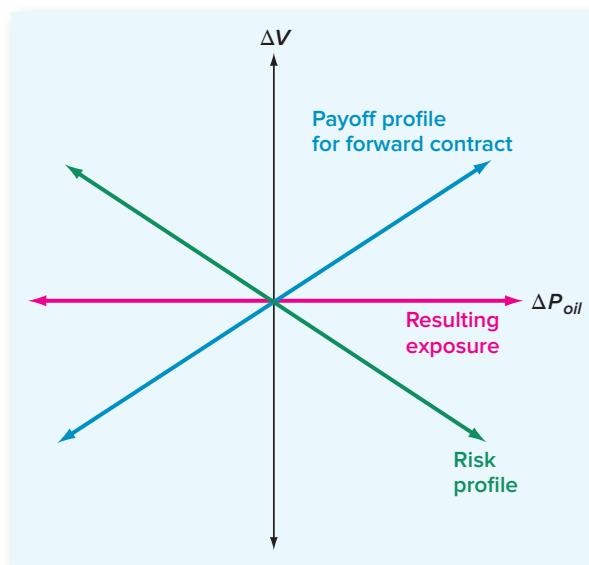


FIGURE 23.5
Hedging with Forward
Contracts

Our public utility example illustrates the fundamental approach to managing financial risk. We first identify the firm's exposure to financial risk using a risk profile. We then try to find a financial arrangement, such as a forward contract, that has an offsetting payoff profile.

A Caveat Figure 23.5 shows that the utility's net exposure to oil price fluctuations is zero. If oil prices rise, then the gains on the forward contract will offset the damage from increased costs. However, if oil prices decline, the benefit from lower costs will be offset by losses on the forward contract.

An important thing to remember about hedging with forward contracts is that price fluctuations can be good or bad, depending on which way they go. If we hedge with forward contracts, we eliminate the risk associated with an adverse price change. However, we also

eliminate the potential gain from a favorable move. You might wonder if we couldn't somehow just hedge against unfavorable moves. We can, and we describe how in a subsequent section.

Credit Risk Another important thing to remember is that with a forward contract, no money changes hands when the contract is initiated. The contract is an agreement to transact in the future, so there is no up-front cost to the contract. However, because a forward contract is a financial obligation, there is credit risk. When the settlement date arrives, the party on the losing end of the contract has a significant incentive to default on the agreement. As we discuss in the next section, a variation on the forward contract exists that greatly diminishes this risk.

Forward Contracts in Practice Where are forward contracts commonly used to hedge? Because exchange rate fluctuations can have disastrous consequences for firms that have significant import or export operations, forward contracts are routinely used by such firms to hedge exchange rate risk. For example, Jaguar, the U.K. auto manufacturer (and former subsidiary of Ford Motor Co.), historically hedged the U.S. dollar–British pound exchange rate for six months into the future. (The subject of exchange rate hedging with forward contracts is discussed in greater detail in Chapter 21.)

Concept Questions

- 23.3a** What is a forward contract? Describe the payoff profiles for the buyer and the seller of a forward contract.
- 23.3b** Explain how a firm can alter its risk profile using forward contracts.

23.4 Hedging with Futures Contracts

futures contract

A forward contract with the feature that gains and losses are realized each day rather than only on the settlement date.

A **futures contract** is exactly the same as a forward contract with one exception. With a forward contract, the buyer and seller realize gains or losses only on the settlement date. With a futures contract, gains and losses are realized daily. If we buy a futures contract on oil, then if oil prices rise today, we have a profit and the seller of the contract has a loss. The seller pays up, and we start again tomorrow with neither party owing the other.

The daily resettlement feature found in futures contracts is called *marking-to-market*. As we mentioned earlier, there is a significant risk of default with forward contracts. With daily marking-to-market, this risk is greatly reduced. This is probably why organized trading is much more common in futures contracts than in forward contracts (outside of international trade).

TRADING IN FUTURES

In the United States and elsewhere around the world, futures contracts for a remarkable variety of items are routinely bought and sold. The types of contracts available are traditionally divided into two groups: Commodity futures and financial futures. With a financial future, the underlying goods are financial assets such as stocks, bonds, or currencies. With a commodity future, the underlying goods can be just about anything other than a financial asset.

There are commodity futures contracts on a wide variety of agricultural products such as corn, orange juice, and, yes, pork bellies. There is even a contract on fertilizer. There are

commodity contracts on precious metals such as gold and silver, and there are contracts on basic goods such as copper and lumber. There are contracts on various petroleum products such as crude oil, heating oil, and gasoline. Wherever there is price volatility, there may be a demand for a futures contract, and new futures contracts are introduced on a fairly regular basis.

FUTURES EXCHANGES

There are a number of futures exchanges in the United States and elsewhere, and more are being established. The Chicago Board of Trade (CBT) is among the largest. Other notable exchanges include the Chicago Mercantile Exchange (CME), the London International Financial Futures and Options Exchange (LIFFE), and the New York Mercantile Exchange (NYMEX).

Table 23.1 gives a partial *Wall Street Journal* listing for selected futures contracts. Taking a look at the corn contracts in the left portion of the table (under the Agriculture Futures heading), note that the contracts trade on the CBT, one contract calls for the delivery of 5,000 bushels of corn, and prices are quoted in cents per bushel. The months in which the contracts mature are given in the first column.

For the corn contract with a March maturity, the first number in the row is the opening price (369.50 cents per bushel), the next number is the high price for the day (372.75), and the following number is the low price for the day (367.50). The *settlement price* is the fourth number (369.50), and it is essentially the closing price for the day. For purposes of marking-to-market, this is the figure used. The change listed next is the movement in the settlement price since the previous trading session. Finally, the *open interest* (500,405), the number of contracts outstanding at the end of the day, is shown.

To see how large futures trading can be, take a look at the CBT Treasury note contracts (under the Interest Rate Futures heading). One contract is for Treasury notes with a face, or par, value of \$100,000. The total open interest for all months is about 3.17 million contracts. The total face value outstanding is therefore \$317 billion for this one type of contract!

HEDGING WITH FUTURES

Hedging with futures contracts is conceptually identical to hedging with forward contracts, and the payoff profile on a futures contract is drawn just like the profile for a forward contract. The only difference in hedging with futures is that the firm will have to maintain an account with a broker so that gains and losses can be credited or debited each day as a part of the marking-to-market process.

Even though many types of futures contracts exist, it is unlikely that a particular firm will be able to find the precise hedging instrument it needs. We might produce a particular grade or variety of oil but find that no contract exists for exactly that grade. However, all oil prices tend to move together, so we could hedge our output using futures contracts on other grades of oil. Airlines hedge jet fuel costs using heating oil contracts. Using a contract on a related, but not identical, asset as a means of hedging is called **cross-hedging**.

When a firm does cross-hedge, it does not actually want to buy or sell the underlying asset. This presents no problem because the firm can reverse its futures position at some point before maturity. This means that if the firm sells a futures contract to hedge something, then it will buy the same contract at a later date, thereby eliminating its futures position. In fact, futures contracts are rarely held to maturity by anyone (despite horror stories of individuals waking up to find mountains of soybeans in their front yards); as a result, actual physical delivery very rarely takes place.



Surf over to the home pages of two of these exchanges at www.cmegroup.com and derivatives.euronext.com.

These websites provide a great deal of information about the services and financial products found on the respective exchanges.



To get some real-world experience at very low cost, visit the fascinating futures exchange at the University of Iowa: tippie.biz.uiowa.edu/tem.

cross-hedging

Hedging an asset with contracts written on a closely related, but not identical, asset.

TABLE 23.1 Sample *Wall Street Journal* Futures Price Quotations

Metal & Petroleum Futures							
	Contract						
	Open	High	hi lo	Low	Settle	Chg	Open interest
Copper-High (CMX)-25,000 lbs; \$ per lb.							
Feb	2.6735	2.6735		2.6715	2.6480	-0.0125	672
March	2.6660	2.6765		2.6410	2.6535	-0.0130	120,434
Gold (CMX)-100 troy oz; \$ per troy oz.							
Feb	1239.40	1243.50		1226.90	1235.10	-2.50	1,387
April	1242.70	1246.20		1226.10	1236.80	-2.70	288,888
June	1246.10	1249.00		1230.00	1240.00	-2.70	63,531
Aug	1250.10	1252.00		1235.10	1243.10	-2.80	18,296
Dec	1254.00	1256.90		1239.00	1249.20	-2.70	29,516
June'18	1266.00	1266.00		1254.80	1259.00	-2.50	4,419
Palladium (NYM)-50 troy oz; \$ per troy oz.							
Feb	732.85	732.85		732.85	772.60	2.80	1
March	770.60	778.80		768.00	772.55	2.80	22,948
June	771.00	780.00		770.40	774.00	2.85	6,503
Sept	775.30	777.00		775.10	775.00	3.60	17
Platinum (NYM)-50 troy oz; \$ per troy oz							
Feb	978.80	979.10		978.80	1019.20	2.80	42
April	1019.60	1032.10	▲	1016.20	1022.20	2.80	59,479
Silver (CMX)-5,000 troy oz; \$ per troy oz.							
Feb	17.750	17.815	▲	17.750	17.720	0.037	179
March	17.780	17.845		17.615	17.741	0.036	113,427
Crude Oil, Light Sweet (NYM)-1,000 bbls; \$ per bbl.							
March	52.37	53.21		52.37	53.00	0.66	385,634
April	52.98	53.70		52.95	53.46	0.55	280,780
May	53.42	54.10		53.41	53.88	0.51	192,554
June	53.90	54.45		53.90	54.25	0.49	264,679
Dec	54.79	55.35		54.79	55.21	0.49	229,809
Dec'18	55.10	55.50		55.04	55.32	0.37	111,505
NY Harbor ULSD (NYM)-42,000 gal; \$ per gal.							
March	1.6360	1.6624		1.6345	1.6415	.0055	111,133
April	1.6443	1.6693		1.6435	1.6500	.0059	72,273
Gasoline-NY RBOB (NYM)-42,000 gal; \$ per gal.							
March	1.5510	1.5811		1.5471	1.5702	.0175	112,099
April	1.7600	1.7800		1.7575	1.7741	.0122	85,512
Natural Gas (NYM)-10,000 MMBtu; \$ per MMBtu.							
March	3.143	3.189		3.110	3.141	.015	197,215
April	3.212	3.253		3.179	3.209	.013	146,224
May	3.269	3.311		3.240	3.272	.017	137,143
June	3.339	3.365		3.298	3.330	.019	79,485
July	3.385	3.413		3.350	3.380	.020	79,570
Oct	3.385	3.423		3.358	3.392	.020	93,442
Agriculture Futures							
Corn(CBT)-5,000 bu; cents per bu.							
March	369.50	372.75	▲	367.50	369.50	-1.25	500,405
May	377.25	380.25	▲	375.25	377.25	-1.25	346,739
Oats(CBT)-5,000 bu; cents per bu.							
March	256.00	257.50		250.00	254.50	.50	4,155
May	248.25	254.00		246.00	253.00	3.00	3,027
Soybeans (CBT)-5,000 bu; cents per bu.							
March	75.43	76.13		75.25	75.58	.33	104,332
Metal & Petroleum Futures							
	Contract						
	Open	High	hi lo	Low	Settle	Chg	Open interest
March	1057.00	1061.50		1045.00	1050.50	-.825	248,998
May	1067.25	1071.50		1055.50	1061.50	-.775	210,368
Soybean Meal (CBT)-100 tons; \$ per ton.							
March	340.70	341.60		335.90	338.40	-.280	126,399
May	344.80	345.80		340.10	342.60	-.270	122,484
Soybean Oil (CBT)-60,000 lbs; cents per lb.							
March	34.67	34.98		34.47	34.67	-.02	123,991
May	34.96	35.26		34.76	34.95	-.03	118,319
Rough Rice (CBT)-2,000 cwt; \$ per cwt.							
March	953.00	960.50		942.00	947.50	-.800	9,388
May	978.50	984.50		968.00	972.50	-.850	2,516
Wheat (CBT)-5,000 bu; cents per bu.							
March	430.50	444.00	▲	429.50	443.50	11.00	179,982
May	442.00	455.50	▲	440.75	455.25	11.75	137,497
Wheat (KC)-5,000 bu; cents per bu.							
March	440.25	451.75		438.25	451.25	9.25	71,740
July	465.25	475.25		462.75	475.00	8.50	69,377
Wheat (MPLS)-5,000 bu; cents per bu.							
March	557.50	569.50		556.00	568.50	11.00	24,788
May	556.75	567.00		555.50	566.50	9.25	29,537
Cattle-Feeder (CME)-50,000 lbs.; cents per lb.							
March	122.525	123.800		121.900	123.625	1.325	19,575
April	123.250	124.200		122.450	124.050	1.075	10,511
Cattle-Live (CME)-40,000 lbs; cents per lb.							
Feb	117.250	117.750		116.775	117.650	.875	17,410
April	115.000	115.175		114.125	114.825	.075	144,593
Hogs-Lean (CME)-40,000 lbs; cents per lb.							
Feb	73.900	74.500	▲	73.550	74.225	.875	14,671
April	72.125	72.250		70.625	70.775	-.950	104,603
Lumber (CME)-110,000 bd. ft., \$ per 1,000 bd. ft.							
March	381.70	381.70	▲	373.80	375.40	3.50	2,698
May	379.60	381.70	▲	375.90	378.40	2.60	1,541
Milk (CME)-200,000 lbs.; cents per lb.							
Feb	16.87	16.89		16.79	16.85	...	4,180
March	16.91	17.03		16.73	16.97	.03	4,392
Cocoa (ICE-US)-10 metric tons; \$ per ton.							
March	1,993	2,018	▼	1,969	1,974	-.19	35,455
May	2,008	2,038	▼	1,988	1,996	-.15	105,293
Coffee (ICE-US)-37,500 lbs; cents per lb.							
March	143.40	145.70		142.85	145.20	2.30	43,558
May	145.95	148.05		145.25	147.60	2.30	73,254
Sugar-World (ICE-US)-112,000 lbs; cents per lb.							
March	20.74	21.03		20.62	20.65	-.11	220,619
May	20.72	20.97		20.61	20.65	-.08	224,526
Sugar-Domestic (ICE-US)-112,000 lbs; cents per lb.							
May	30.40	30.40		30.40	30.32	.07	946
July	30.40	30.40		30.39	30.40	...	1,768
Cotton (ICE-US)-50,000 lbs; cents per lb.							
March	75.43	76.13		75.25	75.58	.33	104,332

TABLE 23.1 (continued)

Metal & Petroleum Futures							
	Contract						
	Open	High	hi lo	Low	Settle	Chg	Open interest
May	76.40	77.30		76.40	76.65	.22	97,772
Orange Juice (ICE-US) -15,000 lbs; cents per lb.							
March	172.65	175.00		171.55	174.00	1.00	7,438
May	167.80	169.75		166.80	168.75	.60	3,434
Interest Rate Futures							
Treasury Bonds(CBT) -\$100,000; pts 32nds of 100%							
March	153-160	153-170		151-310	152-060	-1-030	622,929
June	152-060	152-060		150-240	150-300	-1-030	2,310
Treasury Notes (CBT) -\$100,000; pts 32nds of 100%							
March	125-155	125-155		124-270	124-295	-.14.0	3,169,794
June	124-265	124-270		124-105	124-120	-.14.5	68,648
5 Yr. Treasury Notes (CBT) -\$100,000; pts 32nds of 100%							
March	118-132	118-132		118-012	118-025	-.8.5	3,119,541
June	118-015	118-015		117-230	117-235	-.9.0	137,090
2 Yr. Treasury Notes (CBT) -\$200,000; pts 32nds of 100%							
March	108-170	108-172		108-142	108-147	-.2.0	1,349,070
June	108-060	108-060		108-060	108-055	-.2.5	8,979
30 Day Federal Funds (CBT) -\$5,000,000; 100-daily avg.							
Feb	99.343	99.345		99.343	99.342	-.001	100,104
April	99.315	99.320	▲	99.305	99.310	-.005	373,852
10 Yr. Del. Int. Rate Swaps (CBT) -\$100,000; pts 32nds of 100%							
March	94.703	94.766		94.359	94.438	-.438	31,717
1 Month Libor (CME) -\$3,000,000; pts of 100%							
Feb	▲	...	99.2275	...	4,896
Eurodollar (CME) -\$1,000,000; pts of 100%							
Feb	98.9650	98.9650		98.9625	98.9625	-.0025	83,716
March	98.9450	98.9450		98.9300	98.9350	-.0100	1,455,611
June	98.8000	98.8000		98.7750	98.7800	-.0200	1,434,355
Dec	98.5400	98.5450		98.5000	98.5050	-.0300	1,350,776
Currency Futures							
Japanese Yen (CME) -\$12,500,000; \$ per 100¥							
March	.8948	.8949		.8829	.8834	-.0097	191,960
June	.8982	.8986		.8868	.8872	-.0096	9,846
Canadian Dollar (CME) -CAD 100,000; \$ per CAD							
March	.7610	.7639		.7596	.7614	.0011	115,305
June	.7619	.7646		.7604	.7622	.0011	2,625
British Pound (CME) -\$62,500; \$ per £							
March	1.2544	1.2589		1.2497	1.2502	-.0031	208,495

Metal & Petroleum Futures							
	Contract						
	Open	High	hi lo	Low	Settle	Chg	Open interest
June	1.2563	1.2616		1.2527	1.2531	-.0032	1,661
Swiss Franc (CME) -CHF 125,000; \$ per CHF							
March	1.0066	1.0079		.9995	.9999	-.0064	47,842
June	1.0100	1.0136		1.0055	1.0058	-.0064	180
Australian Dollar (CME) -AUD 100,000; \$ per AUD							
March	.7636	.7659		.7605	.7622	-.0004	115,779
June	.7617	.7641		.7589	.7605	-.0004	1,205
Sept	.7576	.7611		.7576	.7593	-.0004	688
Mexican Peso (CME) -MXN 500,000; \$ per MXN							
March	.04861	.04904		.04847	.04879	.00018	142,828
June	.04791	.04837		.04782	.04811	.00018	47,992
Euro (CME) -€125,000; \$ per €							
March	1.0706	1.0721		1.0662	1.0670	-.0029	391,573
June	1.0746	1.0770		1.0712	1.0720	-.0029	10,473
Index Futures							
Mini DJ Industrial Average (CBT) -\$5 x index							
March	20010	20158	▲	19982	20136	134	126,519
June	19921	20093	▲	19921	20073	136	893
S&P 500 Index (CME) -\$250 x index							
March	2290.70	2307.50	▲	2288.30	2304.30	14.10	68,270
June	2295.50	2302.90	▲	2295.50	2299.10	14.20	1,259
Mini S&P 500(CME) -\$50 x index							
March	2290.50	2307.75	▲	2287.75	2304.25	14.00	2,882,114
June	2285.00	2302.75	▲	2282.50	2299.00	14.00	36,548
Mini S&P Midcap 400 (CME) -\$100 x index							
March	1694.30	1712.80		1691.70	1709.70	16.30	94,526
Mini Nasdaq 100 (CME) -\$20 x index							
March	5189.8	5219.3	▲	5186.3	5212.3	21.0	233,819
June	5193.3	5217.8	▲	5186.0	5211.3	21.0	621
Mini Russell 2000 (ICE-US) -\$100 x index							
March	1356.50	1380.10		1354.60	1377.00	21.00	613,166
June	1357.30	1375.70		1357.30	1374.30	21.00	540
Mini Russell 1000 (ICE-US) -\$100 x index							
March	1275.10	1282.10	▲	1274.60	1280.60	8.50	7,872
U.S. Dollar Index (ICE-US) -\$1,000 x index							
March	100.24	100.67		100.08	100.65	.38	69,426
June	100.22	100.58		100.05	100.56	.36	2,792

SOURCES: SIX Financial Information; *The Wall Street Journal*, February 10, 2017.

A related issue has to do with contract maturity. A firm might wish to hedge over a relatively long period of time, but the available contracts might have shorter maturities. A firm could therefore decide to roll over short-term contracts, but this entails some risks. For example, Metallgesellschaft AG, a German firm, nearly went bankrupt in 1993 after losing more than \$1 billion in the oil markets, mainly through derivatives. The trouble began in 1992 when MG Corp., a U.S. subsidiary, began marketing gasoline, heating oil, and diesel fuel. It entered into contracts to supply products for fixed prices for up to 10 years. Thus, if the price of oil rose, then the firm stood to lose money. MG protected itself by, among other things, buying short-term oil futures that fluctuated with near-term energy prices. Under



For information about the regulation of futures contracts, go to the Commodity Futures Trading Commission at www.cftc.gov.

these contracts, if the price of oil rose, the derivatives gained in value. Unfortunately for MG, oil prices dropped, and the firm incurred huge losses on its short-term derivatives positions without an immediate, offsetting benefit on its long-term contracts. Its primary problem was that it was hedging a long-term contract with short-term contracts, a less than ideal approach.

Concept Questions

23.4a What is a futures contract? How does it differ from a forward contract?

23.4b What is cross-hedging? Why is it important?

23.5 Hedging with Swap Contracts

swap contract

An agreement by two parties to exchange, or swap, specified cash flows at specified intervals in the future.

As the name suggests, a **swap contract** is an agreement by two parties to exchange, or swap, specified cash flows at specified intervals. Swaps are a recent innovation; they were first introduced to the public in 1981 when IBM and the World Bank entered into a swap agreement. The market for swaps has grown tremendously since that time.

A swap contract is really just a portfolio, or series, of forward contracts. Recall that with a forward contract, one party promises to exchange an asset (such as bushels of wheat) for another asset (cash) on a specific future date. With a swap, the only difference is that there are multiple exchanges instead of just one. In principle, a swap contract could be tailored to exchange just about anything. In practice, most swap contracts fall into one of three basic categories: Currency swaps, interest rate swaps, and commodity swaps. Other types will surely develop, but we will concentrate on just these three.

CURRENCY SWAPS

With a *currency swap*, two parties agree to exchange a specific amount of one currency for a specific amount of another at specific dates in the future. Suppose a U.S. firm has a German subsidiary and wishes to obtain debt financing for an expansion of the subsidiary's operations. Because most of the subsidiary's cash flows are in euros, the company would like the subsidiary to borrow and make payments in euros, thereby hedging against changes in the euro–dollar exchange rate. Unfortunately, the company has good access to U.S. debt markets but not to German debt markets.

At the same time, a German firm would like to obtain U.S. dollar financing. It can borrow cheaply in euros, but not in dollars. Both firms face a similar problem. They can borrow at favorable rates—but not in the desired currency. A currency swap is a solution. These two firms agree to exchange dollars for euros at a fixed rate at specific future dates (the payment dates on the loans). Each firm obtains the best possible rate and then arranges to eliminate exposure to exchange rate changes by agreeing to exchange currencies, a neat solution.



A great place to get information about swaps is the International Swaps and Derivatives Association website at www.isda.org.

INTEREST RATE SWAPS

Imagine the following scenario: A firm wishes to obtain a fixed-rate loan but can get a good deal on only a floating-rate loan—that is, a loan for which the payments are adjusted periodically to reflect changes in interest rates. Another firm can obtain a fixed-rate loan, but wishes to obtain the lowest possible interest rate; it is willing to take a floating-rate loan. (Rates on floating-rate loans are generally lower than rates on fixed-rate loans; why?) Both firms could accomplish their objectives by agreeing to exchange loan payments; in other words, the two firms could agree to make each other's loan payments. This is an example of an *interest rate swap*; what is really being exchanged is a floating interest rate for a fixed one.

Interest rate swaps and currency swaps are often combined. One firm obtains floating-rate financing in a particular currency and swaps it for fixed-rate financing in another currency. Also, note that payments on floating-rate loans are always based on some index, such as the one-year Treasury rate. An interest rate swap might involve exchanging one floating-rate loan for another as a way of changing the underlying index.

COMMODITY SWAPS

As the name suggests, a *commodity swap* is an agreement to exchange a fixed quantity of a commodity at fixed times in the future. Commodity swaps are the newest type of swap, and the market for them is small relative to that for other types. The potential for growth is enormous, however.

Swap contracts for oil have been engineered. Say that an oil user has a need for 20,000 barrels every quarter. The oil user could enter into a swap contract with an oil producer to supply the needed oil. What price would they agree on? As we mentioned previously, they can't fix a price forever. Instead, they could agree that the price would be equal to the *average* daily oil price from the previous 90 days. As a result of using an average price, the impact of the relatively large daily price fluctuations in the oil market would be reduced, and both firms would benefit from a reduction in transactions exposure.

THE SWAP DEALER

Unlike futures contracts, swap contracts are not traded on organized exchanges. The main reason is that they are not sufficiently standardized. Instead, the *swap dealer* plays a key role in the swaps market. In the absence of a swap dealer, a firm that wished to enter into a swap would have to track down another firm that wanted the opposite end of the deal. This search would probably be expensive and time-consuming.

Instead, a firm wishing to enter into a swap agreement contacts a swap dealer, and the swap dealer takes the other side of the agreement. The swap dealer will then try to find an offsetting transaction with some other party or parties (perhaps another firm or another dealer). Failing this, a swap dealer will hedge its exposure using futures contracts.

Commercial banks are the dominant swap dealers in the United States. As a large swap dealer, a bank would be involved in a variety of contracts. It would be swapping fixed-rate loans for floating-rate loans with some parties and doing just the opposite with other participants. The total collection of contracts in which a dealer is involved is called the *swap book*. The dealer will try to keep a balanced book to limit its net exposure. A balanced book is often called a *matched* book.

INTEREST RATE SWAPS: AN EXAMPLE

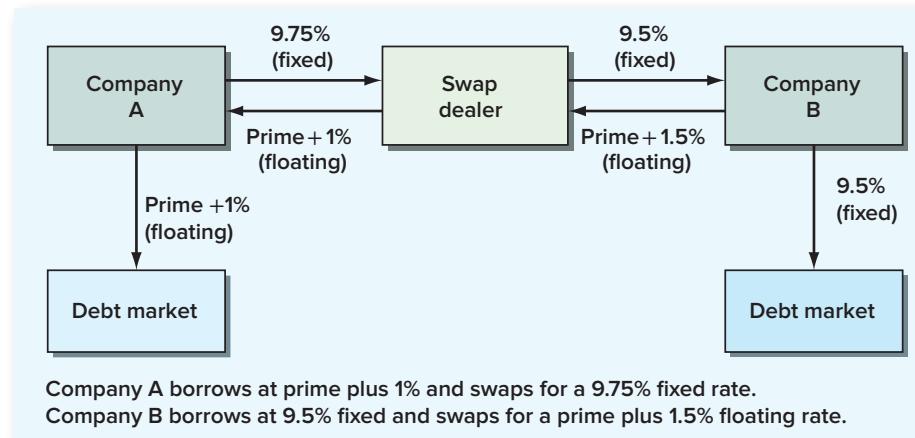
To get a better understanding of swap contracts and the role of the swap dealer, we consider a floating-for-fixed interest rate swap. Suppose Company A can borrow at a floating rate equal to prime plus 1 percent or at a fixed rate of 10 percent. Company B can borrow at a floating rate of prime plus 2 percent or at a fixed rate of 9.5 percent. Company A desires a fixed-rate loan, whereas Company B desires a floating-rate loan. Clearly, a swap is in order.

Company A contacts a swap dealer, and a deal is struck. Company A borrows the money at a rate of prime plus 1 percent. The swap dealer agrees to cover the loan payments; in exchange, the company agrees to make fixed-rate payments to the swap dealer at a rate of, say, 9.75 percent. Notice that the swap dealer is making floating-rate payments and receiving fixed-rate payments. The company is making fixed-rate payments, so it has swapped a floating payment for a fixed one.

Company B also contacts a swap dealer. The deal here calls for Company B to borrow the money at a fixed rate of 9.5 percent. The swap dealer agrees to cover the fixed loan

FIGURE 23.6

Illustration of an Interest Rate Swap



payments, and the company agrees to make floating-rate payments to the swap dealer at a rate of prime plus, say, 1.5 percent. In this second arrangement, the swap dealer is making fixed-rate payments and receiving floating-rate payments.

What's the net effect of these machinations? First, Company A gets a fixed-rate loan at a rate of 9.75 percent, which is cheaper than the 10 percent rate it can obtain on its own. Second, Company B gets a floating-rate loan at prime plus 1.5 percent instead of prime plus 2 percent. The swap benefits both companies.

The swap dealer also wins. When all the dust settles, the swap dealer receives (from Company A) fixed-rate payments at a rate of 9.75 percent and makes fixed-rate payments (for Company B) at a rate of 9.5 percent. At the same time, it makes floating-rate payments (for Company A) at a rate of prime plus 1 percent and receives floating-rate payments at a rate of prime plus 1.5 percent (from Company B). Notice that the swap dealer's book is perfectly balanced in terms of risk, and it has no exposure to interest rate volatility.

Figure 23.6 illustrates the transactions in our interest rate swap. Notice that the essence of the swap transactions is that one company swaps a fixed payment for a floating payment, while the other exchanges a floating payment for a fixed one. The swap dealer acts as an intermediary and profits from the spread between the rates it charges and the rates it receives.

Concept Questions

23.5a What is a swap contract? Describe three types.

23.5b Describe the role of the swap dealer.

23.5c Explain the cash flows in Figure 23.6.

23.6 Hedging with Option Contracts

The contracts we have discussed thus far—forward, futures, and swaps—are conceptually similar. In each case, two parties agree to transact on a future date or dates. The key is that both parties are obligated to complete the transaction.

In contrast, an **option contract** is an agreement that gives the owner the right, but not the obligation, to buy or sell (depending on the option type) some asset at a specified price for a specified time. Options are covered in detail elsewhere in our book. Here we will quickly discuss some option basics and then focus on using options to hedge volatility in commodity prices, interest rates, and exchange rates. In doing so, we will sidestep a wealth of detail concerning option terminology, option trading strategies, and option valuation.

option contract

An agreement that gives the owner the right, but not the obligation, to buy or sell a specific asset at a specific price for a set period of time.

OPTION TERMINOLOGY

Options come in two flavors: Puts and calls. The owner of a **call option** has the right, but not the obligation, to buy an underlying asset at a fixed price, called the *strike price* or *exercise price*, for a specified time. The owner of a **put option** has the right, but not the obligation, to sell an underlying asset at a fixed price for a specified time.

The act of buying or selling the underlying asset using the option contract is called *exercising* the option. Some options (“American” options) can be exercised anytime up to and including the *expiration date* (the last day); other options (“European” options) can be exercised only on the expiration date. Most options are American.

Because the buyer of a call option has the right to buy the underlying asset by paying the strike price, the seller of a call option is obligated to deliver the asset and accept the strike price if the option is exercised. Similarly, the buyer of the put option has the right to sell the underlying asset and receive the strike price. In this case, the seller of the put option must accept the asset and pay the strike price.

OPTIONS VERSUS FORWARDS

There are two key differences between an option contract and a forward contract. The first is obvious. With a forward contract, both parties are obligated to transact; one party delivers the asset, and the other party pays for it. With an option, the transaction occurs only if the owner of the option chooses to exercise it.

The second difference between an option and a forward contract is that no money changes hands when a forward contract is created, but the buyer of an option contract gains a valuable right and must pay the seller for that right. The price of the option is frequently called the *option premium*.

OPTION PAYOFF PROFILES

Figure 23.7 shows the general payoff profile for a call option from the owner's viewpoint. The horizontal axis shows the difference between the asset's value and the strike price on the

call option

The right to buy an asset at a fixed price during a particular period.

put option

The right to sell an asset at a fixed price during a particular period of time. The opposite of a call option.



The Chicago Board Options Exchange (CBOE) is the world's largest options exchange. Make a virtual visit at www.cboe.com.

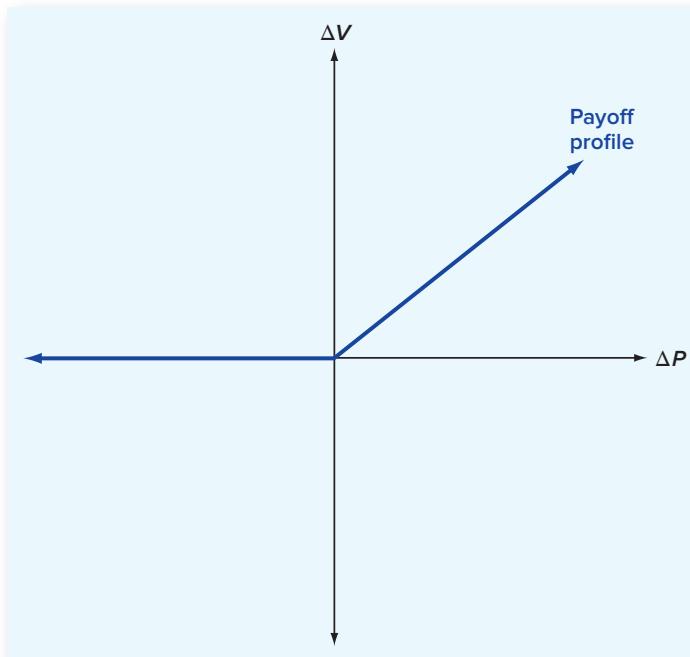
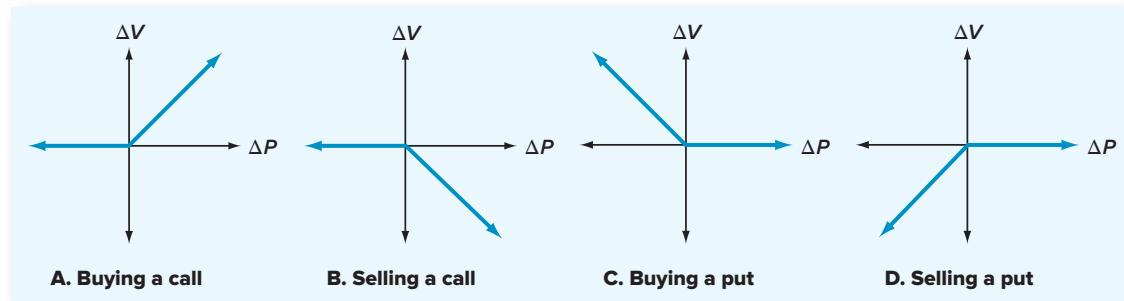


FIGURE 23.7

Call Option Payoff Profile for an Option Buyer

FIGURE 23.8 Option Payoff Profiles

A good introduction to the options markets is available at www.optionseducation.org.

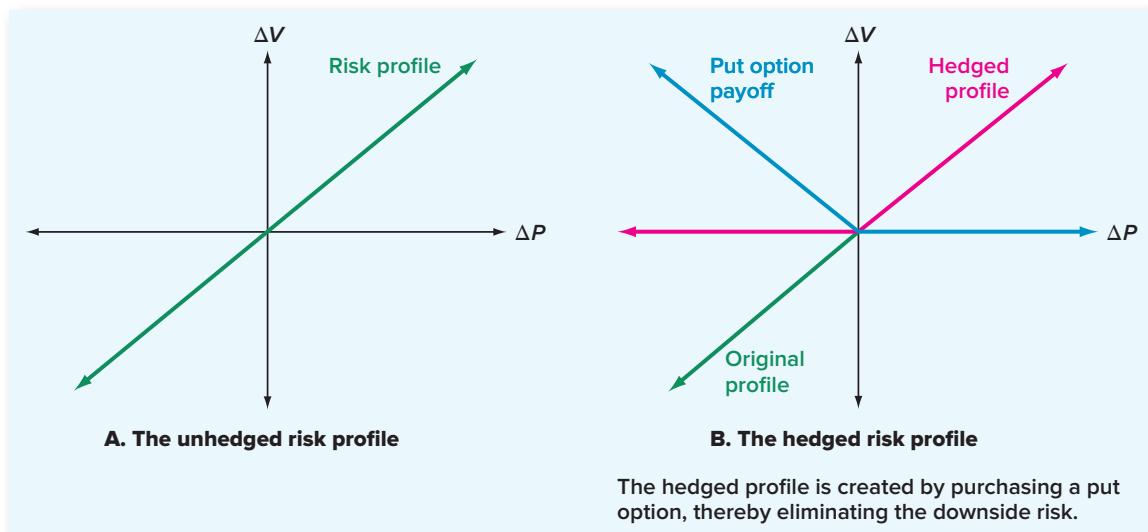
option (ΔP). As illustrated, if the price of the underlying asset rises above the strike price, then the owner of the option will exercise the option and enjoy a profit (ΔV). If the value of the asset falls below the strike price, the owner of the option will not exercise it. Notice that this payoff profile does not consider the premium that the buyer paid for the option.

The payoff profile that results from buying a call is repeated in Part A of Figure 23.8. Part B shows the payoff profile on a call option from the seller's side. A call option is a zero-sum game, so the seller's payoff profile is exactly the opposite of the buyer's.

Part C of Figure 23.8 shows the payoff profile for the buyer of a put option. In this case, if the asset's value falls below the strike price, then the buyer profits because the seller of the put must pay the strike price. Part D shows that the seller of the put option loses out when the price falls below the strike price.

OPTION HEDGING

Suppose a firm has a risk profile that looks like the one in Part A of Figure 23.9. If the firm wishes to hedge against adverse price movements using options, what should it do? Examining the different payoff profiles in Figure 23.8, we see that the one that has the desirable shape is C, buying a put. If the firm buys a put, then its net exposure is as illustrated in Part B of Figure 23.9.

FIGURE 23.9 Hedging with Options

In this case, by buying a put option, the firm has eliminated the downside risk—that is, the risk of an adverse price movement. However, the firm has retained the upside potential. In other words, the put option acts as a kind of insurance policy. Remember that this desirable insurance is not free: The firm pays for it when it buys the put option.

HEDGING COMMODITY PRICE RISK WITH OPTIONS

We saw earlier that futures contracts are available for a variety of basic commodities. In addition, an increasing number of options are available on these same commodities. In fact, the options that are typically traded on commodities are actually options on futures contracts; for this reason, they are called *futures options*.

These work as follows: When a futures call option on wheat is exercised, the owner of the option receives two things. The first is a futures contract on wheat at the current futures price. This contract can be immediately closed at no cost. The second thing the owner of the option receives is the difference between the strike price on the option and the current futures price. The difference is paid in cash.

Table 23.2 gives corn futures options quotations from the CME Group website with a May 2017 expiration. Note that the middle column of numbers tells us the different strike prices that are available.² The “High” and “Low” columns are the high and low price of the day, the “Prior Settle” column is essentially the closing price yesterday, and the “Last” column is the price of the most recent trade. In the quote, you will notice the apostrophe. These contracts are traded in eighths. The last trade on the May 375 put was 17'1, which is 17 1/8 cents, or \$.17125.

Suppose you buy the May 395 corn futures call option. You will pay \$.08375 per bushel for the option (they’re actually sold in multiples of 5,000, but we’ll ignore this). If you exercise your option, you will receive a futures contract on corn and a cash payment for the difference between the current futures price and the strike price of \$3.95.

HEDGING EXCHANGE RATE RISK WITH OPTIONS

Futures options are available on foreign currencies as well as on commodities. These work in exactly the same way as commodities futures options. In addition, there are other traded options for which the underlying asset is currency rather than a futures contract on a currency. Firms with significant exposure to exchange rate risk frequently purchase put options to protect against adverse exchange rate changes.

HEDGING INTEREST RATE RISK WITH OPTIONS

The use of options to hedge against interest rate risk is a very common practice, and there are a variety of options available to serve this purpose. Some are futures options like the ones we have been discussing, and these trade on organized exchanges. For example, we mentioned the Treasury note contract in our discussion of futures. There are options available on this contract and a number of other financial futures as well. Beyond this, there is a thriving over-the-counter market in interest rate options. We will describe some of these options in this section.

A Preliminary Note Some interest rate options are actually options on interest-bearing assets such as bonds (or on futures contracts for bonds). Most of the options that are traded on exchanges fall into this category. As we will discuss in a moment, some others are actually options on interest rates. The distinction is important if we are thinking about using one type or the other to hedge. To illustrate, suppose we want to protect ourselves against an increase in interest rates using options; what should we do?

We need to buy an option that increases in value as interest rates go up. One thing we can do is buy a *put* option on a bond. Why a put? Remember that when interest rates go up,



The Association of Corporate Treasurers (www.treasurers.org) has lots of information about a variety of subjects, including risk management.

²Notice that the strike prices are all quoted in cents; for example, the first entry is 360.0, meaning \$3.60 per bushel.

TABLE 23.2
**Sample CME Group
Futures Options Price
Quotations**

Underlying Future		Charts	Last	Change	Prior Settle	High	Low	Volume	Hi / Low Limit	Updated					
May 2017			381'4	+4'2	377'2	382'6	376'0	122,909	407'0 / 357'0	16:38:37 CT 10 Feb 2017					
Type: American Options Expiration: May 2017 Strike Range: At The Money															
Calls															
Puts															
Updated: 16:38:57 CT 10 Feb 2017															
No Limit / 0'	231	27'4	23'7	22'7	+4'0	26'7	360.0	5'1	-0'4	5'5	5'0	5'3	591	No Limit / 0'	16:38:02 CT 10 Feb 2017
No Limit / 0'	2	23'5	23'5	19'5	+4'0	23'5	365.0	6'7	-0'4	7'3	6'3	7'0	676	No Limit / 0'	16:38:54 CT 10 Feb 2017
No Limit / 0'	702	20'5	19'1	16'6	+3'1	19'7	370.0	8'6	-0'6	9'4	8'1	9'7	917	No Limit / 0'	16:38:06 CT 10 Feb 2017
No Limit / 0'	357	17'1	16'3	14'1	+3'0	17'1	375.0	10'3	-1'4	11'7	10'3	10'7	3,949	No Limit / 0'	16:38:06 CT 10 Feb 2017
No Limit / 0'	924	15'0	12'3	11'7	+3'1	15'0	380.0	12'7	-1'6	14'5	12'6	14'1	1,085	No Limit / 0'	16:38:24 CT 10 Feb 2017
No Limit / 0'	44	12'5	12'0	9'7	+2'6	12'5	385.0	-	-	17'5	-	-	0	No Limit / 0'	16:38:09 CT 10 Feb 2017
No Limit / 0'	496	11'0	8'4	8'1	+2'4	10'5	390.0	19'1	-1'6	20'7	18'6	20'0	183	No Limit / 0'	16:38:47 CT 10 Feb 2017
No Limit / 0'	53	8'3	7'7	6'6	+1'5	8'3	395.0	-	-	24'3	-	-	0	No Limit / 0'	16:38:28 CT 10 Feb 2017
No Limit / 0'	230	7'5	5'6	5'4	+2'1	7'5	400.0	-	-	28'2	-	-	11	No Limit / 0'	16:38:41 CT 10 Feb 2017
No Limit / 0'	185	5'7	5'5	4'4	+1'3	5'7	405.0	-	-	32'2	-	-	0	No Limit / 0'	16:39:00 CT 10 Feb 2017

SOURCE: CME Group (www.cmegroup.com), February 10, 2017.

bond values go down; so one way to hedge against interest rate increases is to buy put options on bonds. The other way to hedge is to buy a *call* option on interest rates. We discuss this alternative in more detail in the next section.

We actually saw interest rate options in Chapter 7 when we discussed the call feature on a bond. Remember that the call provision gives the issuer the right to buy back the bond at a set price, known as the *call price*. What happens is that if interest rates fall, the bond's price will rise. If it rises above the call price, the issuer will exercise the option and acquire the bond at a bargain price. The call provision can be viewed as either a call option on a bond or a put option on interest rates.

Interest Rate Caps An *interest rate cap* is a call option on an interest rate. Suppose a firm has a floating-rate loan. It is concerned that interest rates will rise sharply and the firm will experience financial distress because of the increased loan payment. To guard against this, the firm can purchase an interest rate cap from a bank (there are banks that specialize in such products). What will happen is that if the loan payment ever rises above an agreed-upon limit (the “ceiling”), the bank will pay the difference between the actual payment and the ceiling to the firm in cash.

A *floor* is a put option on an interest rate. If a firm buys a cap and sells a floor, the result is a *collar*. By selling the put and buying the call, the firm protects itself against increases in interest rates beyond the ceiling by the cap. However, if interest rates drop below the floor, the put will be exercised against the firm. The result is that the rate the firm pays will not drop below the floor rate. In other words, the rate the firm pays will always be between the floor and the ceiling.

Other Interest Rate Options We will close out our chapter by briefly mentioning two relatively new types of interest rate options. Suppose a firm has a floating-rate loan. The firm is comfortable with its floating-rate loan, but it would like to have the right to convert it to a fixed-rate loan in the future.

What can the firm do? What it wants is the right, but not the obligation, to swap its floating-rate loan for a fixed-rate loan. In other words, the firm needs to buy an option on a swap. Swap options exist, and they have the charming name *swaptions*.

We've seen that there are options on futures contracts and options on swap contracts, but what about options on options? Such options are called *compound* options. As we have just discussed, a cap is a call option on interest rates. Suppose a firm thinks that, depending on interest rates, it might like to buy a cap in the future. As you can probably guess, in this case, what the firm might want to do today is buy an option on a cap. Inevitably, it seems, an option on a cap is called a *caption*, and there is a large market for these instruments.

ACTUAL USE OF DERIVATIVES

Because derivatives do not usually appear in financial statements, it is much more difficult to observe the use of derivatives by firms compared to, say, bank debt. Much of our knowledge of corporate derivative use comes from academic surveys. Most surveys report that the use of derivatives appears to vary widely among large publicly traded firms. Large firms are far more likely to use derivatives than are small firms. Table 23.3 shows that for firms that use derivatives, foreign currency and interest rate derivatives are the most frequently used types.

The prevailing view is that derivatives can be very helpful in reducing the variability of firm cash flows, which, in turn, reduces the various costs associated with financial distress. It is somewhat puzzling that large firms use derivatives more often than small firms—because large firms tend to have less cash flow variability than small firms. Also, some surveys report that firms occasionally use derivatives when they want to speculate about future prices and not just hedge risks.

However, most of the evidence is consistent with the theory that derivatives are most frequently used by firms where financial distress costs are high and access to the capital markets is constrained.

Concept Questions

- 23.6a** Suppose that the unhedged risk profile (Part A) in Figure 23.9 sloped down instead of up. What option-based hedging strategy would be suitable in this case?
- 23.6b** What is a futures option?
- 23.6c** What is a caption? Who might want to buy one?

TABLE 23.3
Derivative Usage:
Survey Results

Percent of Companies Using Derivatives			
	2010	71%	
	2009	79	
In Which Asset Classes Do You Use Derivatives?			
	2010		2009
Interest rates	65%		68%
Currencies	62		58
Credit	13		13
Energy	19		13
Commodities	23		22
Equities	13		9
Do You Expect Your Use of Derivatives to Change?			
	2010		2009
	Increase	Decrease	Increase
Interest rates	19%	15%	13%
Currencies	20	8	31
Credit	4	4	2
Energy	11	7	5
Commodities	16	6	12
Equities	6	7	7
Do You Use an Integrated Risk Management Strategy or Do You Hedge Transactions or Specific Currency Exposures?			
	2010		2009
Hedge total risk	31.8%		21.1%
Hedge transactions	34.1		47.4
Hedge specific currency exposures	34.1		31.6

SOURCE: Adapted from *Treasury & Risk Management* (March 2010 and March 2012).

23.7 Summary and Conclusions

This chapter introduced some of the basic principles of financial risk management and financial engineering. The motivation for risk management and financial engineering stems from the fact that a firm will frequently have an undesirable exposure to some type of risk. This is particularly true today because of the increased volatility in key financial variables such as interest rates, exchange rates, and commodity prices.

We describe a firm's exposure to a particular risk with a risk profile. The goal of financial risk management is to alter the firm's risk profile through buying and selling derivative assets such as futures contracts, swap contracts, and option contracts. By finding instruments with appropriate payoff profiles, a firm can reduce or even eliminate its exposure to many types of risk.

Hedging cannot change the fundamental economic reality of a business. What it can do is allow a firm to avoid expensive and troublesome disruptions that might otherwise result from short-run, temporary price fluctuations. Hedging also gives a firm time to react and

adapt to changing market conditions. Because of the price volatility and rapid economic change that characterize modern business, intelligently dealing with volatility has become an increasingly important task for financial managers.

Many other option types are available in addition to those we have discussed, and more are created every day. One very important aspect of financial risk management that we have not discussed is that options, forwards, futures, and swaps can be combined in a wide variety of ways to create new instruments. These basic contract types are really just the building blocks used by financial engineers to create new and innovative products for corporate risk management.

CONNECT TO FINANCE



Connect Finance offers you plenty of opportunities to practice mastering these concepts. Log on to connect.mheducation.com to learn more. If you like what you see, ask your professor about using *Connect Finance*!

Can you answer the following *Connect Quiz* questions?

Section 23.2 Keith is preparing a graph that compares the value of his firm to various prices for his firm's services. This graph is called a _____.

Section 23.3 A cereal maker needs a large quantity of wheat for its production processes. If the firm manages to completely hedge its risk exposure to wheat prices, then its risk profile for wheat will be _____.

Section 23.6 What is an interest rate cap?

CHAPTER REVIEW AND SELF-TEST PROBLEMS

23.1 Futures Contracts Suppose Golden Grain Farms (GGF) expects to harvest 50,000 bushels of wheat in September. GGF is concerned about the possibility of price fluctuations between now and September. The futures price for September wheat is \$2 per bushel, and the relevant contract calls for 5,000 bushels. What action should GGF take to lock in the \$2 price? Suppose the price of wheat actually turns out to be \$3. Evaluate GGF's gains and losses. Do the same for a price of \$1. Ignore marking to market.

23.2 Options Contracts In the previous question, suppose that September futures put options with a strike price of \$2 per bushel cost \$.15 per bushel. Assuming that GGF hedges using put options, evaluate its gains and losses for wheat prices of \$1, \$2, and \$3.

ANSWERS TO CHAPTER REVIEW AND SELF-TEST PROBLEMS

23.1 GGF wants to deliver wheat and receive a fixed price, so it needs to *sell* futures contracts. Each contract calls for delivery of 5,000 bushels, so GGF needs to sell 10 contracts. No money changes hands today.

If wheat prices actually turn out to be \$3, then GGF will receive \$150,000 for its crop; but it will have a loss of \$50,000 on its futures position when it closes that

position because the contracts require it to sell 50,000 bushels of wheat at \$2, when the going price is \$3. It thus nets \$100,000 overall.

If wheat prices turn out to be \$1 per bushel, then the crop will be worth only \$50,000. However, GGF will have a profit of \$50,000 on its futures position, so GGF again nets \$100,000.

- 23.2** If GGF wants to insure against a price decline only, it can buy 10 put contracts. Each contract is for 5,000 bushels, so the cost per contract is $5,000 \times \$0.15 = \750 . For 10 contracts, the cost will be \$7,500.

If wheat prices turn out to be \$3, then GGF will not exercise the put options (why not?). Its crop is worth \$150,000, but it is out the \$7,500 cost of the options, so it nets \$142,500.

If wheat prices fall to \$1, the crop is worth \$50,000. GGF will exercise its puts (why?) and thereby force the seller of the puts to pay \$2 per bushel. GGF receives a total of \$100,000. If we subtract the cost of the puts, we see that GGF's net is \$92,500. In fact, verify that its net at any price of \$2 or lower is \$92,500.

CONCEPTS REVIEW AND CRITICAL THINKING QUESTIONS

1. **Hedging Strategies [LO1]** If a firm is selling futures contracts on lumber as a hedging strategy, what must be true about the firm's exposure to lumber prices?
2. **Hedging Strategies [LO1]** If a firm is buying call options on pork belly futures as a hedging strategy, what must be true about the firm's exposure to pork belly prices?
3. **Forwards and Futures [LO2]** What is the difference between a forward contract and a futures contract? Why do you think that futures contracts are much more common? Are there any circumstances under which you might prefer to use forwards instead of futures? Explain.
4. **Hedging Commodities [LO1]** Bubbling Crude Corporation, a large Texas oil producer, would like to hedge against adverse movements in the price of oil because this is the firm's primary source of revenue. What should the firm do? Provide at least two reasons why it probably will not be possible to achieve a completely flat risk profile with respect to oil prices.
5. **Sources of Risk [LO1]** A company produces an energy-intensive product and uses natural gas as the energy source. The competition primarily uses oil. Explain why this company is exposed to fluctuations in both oil and natural gas prices.
6. **Hedging Commodities [LO1]** If a textile manufacturer wanted to hedge against adverse movements in cotton prices, it could buy cotton futures contracts or buy call options on cotton futures contracts. What would be the pros and cons of the two approaches?
7. **Options [LO4]** Explain why a put option on a bond is conceptually the same as a call option on interest rates.
8. **Hedging Interest Rates [LO1]** A company has a large bond issue maturing in one year. When it matures, the company will float a new issue. Current interest rates are attractive, and the company is concerned that rates next year will be higher. What are some hedging strategies that the company might use in this case?
9. **Swaps [LO3]** Explain why a swap is effectively a series of forward contracts. Suppose a firm enters into a swap agreement with a swap dealer. Describe the nature of the default risk faced by both parties.

10. **Swaps [LO3]** Suppose a firm enters into a fixed-for-floating interest rate swap with a swap dealer. Describe the cash flows that will occur as a result of the swap.
11. **Transactions versus Economic Exposure [LO1]** What is the difference between transactions and economic exposure? Which can be hedged more easily? Why?
12. **Hedging Exchange Rate Risk [LO2]** If a U.S. company exports its goods to Japan, how would it use a futures contract on Japanese yen to hedge its exchange rate risk? Would it buy or sell yen futures? In answering, assume that the exchange rate quoted in the futures contract is quoted as dollars per yen.
13. **Hedging Strategies [LO1]** For the following scenarios, describe a hedging strategy using futures contracts that might be considered. If you think that a crosshedge would be appropriate, discuss the reasons for your choice of contract.
 - a. A public utility is concerned about rising costs.
 - b. A candy manufacturer is concerned about rising costs.
 - c. A corn farmer fears that this year's harvest will be at record high levels across the country.
 - d. A manufacturer of photographic film is concerned about rising costs.
 - e. A natural gas producer believes there will be excess supply in the market this year.
 - f. A bank derives all its income from long-term, fixed-rate residential mortgages.
 - g. A stock mutual fund invests in large-company blue-chip stocks and is concerned about a decline in the stock market.
 - h. A U.S. importer of Swiss Army knives will pay for its order in six months in Swiss francs.
 - i. A U.S. exporter of construction equipment has agreed to sell some cranes to a German construction firm. The U.S. firm will be paid in euros in three months.
14. **Swaps [LO3]** In 2009 and 2010, investment banks were under fire for interest rate swaps sold to municipalities and nonprofits. For example, California's water resource authority paid about \$305 million, North Carolina paid about \$60 million, and Harvard University paid about \$923 million to unwind swaps agreements. To unwind a swaps position, you make a reverse trade. For example, if you had agreed to a fixed-for-variable swap, you would enter a variable-for-fixed swap. The controversy was caused because many people felt that investment banks had taken advantage of municipalities and nonprofits. Is this argument correct? Why or why not?
15. **Insurance [LO4]** Suppose you own a home that costs \$200,000 and you buy homeowner's insurance to cover your house against fire, wind, tornados, and other disasters. One way to view your insurance is that you purchased an option. What type of option is the homeowner's policy? As the homeowner, are you buying or selling this option?
16. **Insurance [LO4]** With some insurance policies, the value of the asset to be replaced is the current market value. For example, if you bought a couch five years ago for \$1,000, and the current value of the couch is \$300, you would only get \$300 if the couch were destroyed. However, many insurance companies offer a "rider" that gives full replacement. In this case, if a comparable new couch were now \$1,200, you would get the full \$1,200 if your couch were destroyed. How would you view this rider in option terms?

QUESTIONS AND PROBLEMS

**BASIC**

(Questions 1–5)



1. **Futures Quotes [LO2]** Refer to Table 23.1 in the text to answer this question. Suppose you purchase a March 2017 cocoa futures contract this day at the last price of the day. What will your profit or loss be if cocoa prices turn out to be \$1,965 per metric ton at expiration?
2. **Futures Quotes [LO2]** Refer to Table 23.1 in the text to answer this question. Suppose you sell five March 2017 silver futures contracts this day at the last price of the day. What will your profit or loss be if silver prices turn out to be \$17.81 per ounce at expiration? What if silver prices are \$17.64 per ounce at expiration?
3. **Futures Options Quotes [LO4]** Refer to Table 23.2 in the text to answer this question. Suppose you purchase the May 2017 call option on corn futures with a strike price of \$3.85. Assume you purchased the option at the last price. How much does your option cost per bushel of corn? What is the total cost? Suppose the price of corn futures is \$3.74 per bushel at expiration of the option contract. What is your net profit or loss from this position? What if corn futures prices are \$4.13 per bushel at expiration?
4. **Put and Call Payoffs [LO4]** Suppose a financial manager buys call options on 50,000 barrels of oil with an exercise price of \$57 per barrel. She simultaneously sells a put option on 50,000 barrels of oil with the same exercise price of \$57 per barrel. Consider her gains and losses if oil prices are \$52, \$55, \$57, \$59, and \$62. What do you notice about the payoff profile?
5. **Futures Options Quotes [LO4]** Refer to Table 23.2 in the text to answer this question. Suppose you purchase the May 2017 put option on corn futures with a strike price of \$3.80. Assume your purchase was at the last price. What is the total cost? Suppose the price of corn futures is \$3.61 per bushel at expiration of the option contract. What is your net profit or loss from this position? What if corn futures prices are \$3.97 per bushel at expiration?
6. **Insurance [LO1]** Suppose your company has a building worth \$165 million. Because it is located in a high-risk area for natural disasters, the probability of a total loss in any particular year is 1.15 percent. What is your company's expected loss per year on this building?
7. **Hedging with Futures [LO2]** Refer to Table 23.1 in the text to answer this question. Suppose today is February 10, 2017, and your firm produces breakfast cereal and needs 145,000 bushels of corn in May 2017 for an upcoming promotion. You would like to lock in your costs today because you are concerned that corn prices might rise between now and May.
 - a. How could you use corn futures contracts to hedge your risk exposure? What price would you effectively be locking in based on the closing price of the day?
 - b. Suppose corn prices are \$3.69 per bushel in May. What is the profit or loss on your futures position? Explain how your futures position has eliminated your exposure to price risk in the corn market.
8. **Interest Rate Swaps [LO3]** ABC Company and XYZ Company need to raise funds to pay for capital improvements at their manufacturing plants. ABC Company is a well-established firm with an excellent credit rating in the debt market; it can borrow funds either at an 11 percent fixed rate or at LIBOR + 1 percent floating rate. XYZ Company is a fledgling start-up firm without a strong credit history. It can borrow funds either at a 10 percent fixed rate or at LIBOR + 3 percent floating rate.

INTERMEDIATE

(Questions 6–7)

CHALLENGE

(Questions 8–10)

- a. Is there an opportunity here for ABC and XYZ to benefit by means of an interest rate swap?
 - b. Suppose you've just been hired at a bank that acts as a dealer in the swaps market, and your boss has shown you the borrowing rate information for your clients ABC and XYZ. Describe how you could bring these two companies together in an interest rate swap that would make both firms better off while netting your bank a 2.0 percent profit.
9. **Financial Engineering [LO2, 4]** Suppose there were call options and forward contracts available on coal, but no put options. Show how a financial engineer could synthesize a put option using the available contracts. What does your answer tell you about the general relationship among puts, calls, and forwards?
10. **Insurance [LO4]** In calculating insurance premiums, the actuarially fair insurance premium is the premium that results in a zero NPV for both the insured and the insurer. As such, the present value of the expected loss is the actuarially fair insurance premium. Suppose your company wants to insure a building worth \$245 million. The probability of loss is 1.25 percent in one year, and the relevant discount rate is 4 percent.
- a. What is the actuarially fair insurance premium?
 - b. Suppose that you can make modifications to the building that will reduce the probability of a loss to .90 percent. How much would you be willing to pay for these modifications?

MINICASE

Chatman Mortgage, Inc.

Joi Chatman recently received her finance degree and has decided to enter the mortgage broker business. Rather than working for someone else, she will open her own shop. Her cousin Mike has approached her about a mortgage for a house he is building. The house will be completed in three months, and he will need the mortgage at that time. Mike wants a 25-year, fixed-rate mortgage in the amount of \$400,000 with monthly payments.

Joi has agreed to lend Mike the money in three months at the current market rate of 6 percent. Because Joi is just starting out, she does not have \$400,000 available for the loan; she approaches Ian Turnbull, the president of IT Insurance Corporation, about purchasing the mortgage from her in three months. Ian has agreed to purchase the mortgage in three months, but he is unwilling to set a price on the mortgage. Instead, he has agreed in writing to purchase the mortgage at the market rate in three months. There are Treasury bond futures contracts available for delivery in three months. A Treasury bond contract is for \$100,000 in face value of Treasury bonds.

QUESTIONS

1. What is the monthly mortgage payment on Mike's mortgage?
2. What is the most significant risk Joi faces in this deal?
3. How can Joi hedge this risk?
4. Suppose that in the next three months the market rate of interest rises to 7 percent.
 - a. How much will Ian be willing to pay for the mortgage?
 - b. What will happen to the value of Treasury bond futures contracts? Will a long or short position increase in value?
5. Suppose that in the next three months the market rate of interest falls to 5 percent.
 - a. How much will Ian be willing to pay for the mortgage?
 - b. What will happen to the value of T-bond futures contracts? Will a long or short position increase in value?
6. Are there any possible risks Joi faces in using Treasury bond futures contracts to hedge her interest rate risk?

YOU INVEST \$5,000 IN YAHOO! COMMON STOCK and just months later sell the shares for \$7,500, realizing a 50 percent return. Not bad! At the same time, your neighbor invests \$5,000 in Yahoo! stock options, which are worth \$25,000 at expiration—a 400 percent return. Yahoo! Alternatively, your shares fall in value to \$2,500, and you realize a 50 percent loss. Too bad! But at the same time, your neighbor's Yahoo! stock options are now worthless. Clearly, there is a big difference between stock shares and stock options.

In this chapter, we will explore the basics of options and option valuation. As you will see, options show up in many places in corporate finance. In fact, once you know what to look for, you can find them just about everywhere, so understanding how they work is essential.

Learning Objectives

After studying this chapter, you should be able to:

- L01** Lay out the basics of call and put options and explain how to calculate their payoffs and profits.
- L02** List the factors that affect option values and show how to price call and put options using no arbitrage conditions.
- L03** Explain the basics of employee stock options and their benefits and disadvantages.
- L04** Value a firm's equity as an option on the firm's assets.
- L05** Value options in capital budgeting projects, including timing options, the option to expand, the option to abandon, and the option to contract.
- L06** Define the basics of convertible bonds and warrants and how to value them.

©by_adri/StockPhoto/Getty/images

For updates on the latest happenings in finance, visit fundamentals-of-corporate-finance.blogspot.com.

option

A contract that gives its owner the right to buy or sell some asset at a fixed price on or before a given date.

Options are a part of everyday life. “Keep your options open” is sound business advice, and “We’re out of options” is a sure sign of trouble. In finance, an **option** is an arrangement that gives its owner the right to buy or sell an asset at a fixed price anytime on or before a given date. The most familiar options are stock options. These are options to buy and sell shares of common stock, and we will discuss them in some detail in the following sections.

Of course, stock options are not the only options. In fact, at the root of it, many different kinds of financial decisions amount to the evaluation of options. We will show how understanding options adds several important details to the NPV analysis we have discussed in earlier chapters.

Also, virtually all corporate securities have implicit or explicit option features, and the use of such features is growing. As a result, understanding securities that possess option features requires general knowledge of the factors that determine an option's value.

This chapter starts with a description of different types of options. We identify and discuss the general factors that determine option values and show how ordinary debt and equity have optionlike characteristics. We then examine employee stock options and the important role of options in capital budgeting. We conclude by illustrating how option features are incorporated into corporate securities by discussing warrants, convertible bonds, and other optionlike securities.

Options: The Basics

24.1

An option is a contract that gives its owner the right to buy or sell some asset at a fixed price on or before a given date. An option on a building might give the holder of the option the right to buy the building for \$1 million anytime on or before the Saturday prior to the third Wednesday of January 2021.

Options are a unique type of financial contract because they give the buyer the right, but not the obligation, to do something. The buyer uses the option only if it is profitable to do so; otherwise, the option can be thrown away.

There is a special vocabulary associated with options. Here are some important definitions:

1. **Exercising the option:** The act of buying or selling the underlying asset via the option contract is called *exercising the option*.
2. **Strike price**, or exercise price: The fixed price specified in the option contract at which the holder can buy or sell the underlying asset is called the *strike price* or *exercise price*. The strike price is often called the *striking price*.
3. **Expiration date:** An option usually has a limited life. The option is said to expire at the end of its life. The last day on which the option may be exercised is called the *expiration date*.
4. **American and European options:** An American option may be exercised anytime up to and including the expiration date. A European option may be exercised only on the expiration date.

PUTS AND CALLS

Options come in two basic types: Puts and calls. A **call option** gives the owner the right to *buy* an asset at a fixed price during a particular time period. It may help you to remember that a call option gives you the right to "call in" an asset.

A **put option** is essentially the opposite of a call option. Instead of giving the holder the right to buy some asset, it gives the holder the right to *sell* that asset for a fixed exercise price. If you buy a put option, you can force the seller of the option to buy the asset from you for a fixed price and thereby "put it to them."

What about an investor who *sells* a call option? The seller receives money up front and has the *obligation* to sell the asset at the exercise price if the option holder wants it.

exercising the option

The act of buying or selling the underlying asset via the option contract.

strike price

The fixed price in the option contract at which the holder can buy or sell the underlying asset. Also, the *exercise price* or *striking price*.

expiration date

The last day on which an option may be exercised.

American option

An option that may be exercised at any time until its expiration date.

European option

An option that may be exercised only on the expiration date.

call option

The right to buy an asset at a fixed price during a particular period.

put option

The right to sell an asset at a fixed price during a particular period of time. The opposite of a call option.

Similarly, an investor who *sells* a put option receives cash up front and is then obligated to buy the asset at the exercise price if the option holder demands it.¹

The asset involved in an option can be anything. The options that are most widely bought and sold are stock options. These are options to buy and sell shares of stock. Because these are the best-known types of options, we will study them first. As we discuss stock options, keep in mind that the general principles apply to options involving any asset, not just shares of stock.

STOCK OPTION QUOTATIONS

On April 26, 1973, the Chicago Board Options Exchange (CBOE) opened and began organized trading in stock options. Put and call options involving stock in some of the best-known corporations in the United States are traded there. The CBOE is still the largest organized options market, but options are traded in a number of other places today, including the NYSE and NASDAQ. Almost all such options are American (as opposed to European).

A simplified quotation for a CBOE option might look something like this:

Prices at Close June 15, 2017								
RWJ (RWJ)				Underlying Stock Price: \$100.00				
Expiration	Strike	Call			Put			Open Interest
		Last	Volume	Open Interest	Last	Volume	Open Interest	
Jun	95	6	120	400	2	80	1,000	
July	95	6.50	40	200	2.80	100	4,600	
Aug	95	8	70	600	4	20	800	

The first thing to notice here is the company identifier, RWJ. This tells us that these options involve the right to buy or sell shares of stock in the RWJ Corporation. To the right of the company identifier is the closing price on the stock. As of the close of business on the day before this quotation, RWJ was selling for \$100 per share.

The first column in the table shows the expiration months (June, July, and August). All CBOE options expire following the third Friday of the expiration month. The next column shows the strike price. The RWJ options listed here have an exercise price of \$95.

The next three columns give us information about call options. The first thing given is the most recent price (Last). Next, we have volume, which tells us the number of option *contracts* that were traded that day. One option contract involves the right to buy (for a call option) or sell (for a put option) 100 shares of stock, and all trading actually takes place in contracts. Option prices are quoted on a per-share basis.

The last piece of information given for the call options is the open interest. This is the number of contracts of each type currently outstanding. The three columns of information for call options (price, volume, and open interest) are followed by the same three columns for put options.

The first option listed would be described as the “RWJ June 95 call.” The price for this option is **\$6**. If you pay the \$6, then you have the right anytime between now and the third Friday of June to buy one share of RWJ stock for \$95. Because trading takes place in round lots (multiples of 100 shares), one option contract costs you $\$6 \times 100 = \600 .



Check out these options exchanges: www.cboe.com and www.euronext.com

¹An investor who sells an option is often said to have “written” the option.

Calls											Puts				
Last	Change	Bid	Ask	Volume	Open Int.	Strike	Last	Change	Bid	Ask	Volume	Open Int.			
17.15	-0.10	18.00	19.80	24	29	13.00	0.07	-0.02	0.06	0.07	5	2480			
16.10	+1.10	17.20	17.40	1	212	15.00	0.11	-0.02	0.10	0.13	10	3559			
13.26	+1.06	13.00	14.80	10	389	18.00	0.21	-0.03	0.19	0.23	338	7331			
12.00	+0.50	11.40	12.60	5	937	20.00	0.31	-0.01	0.30	0.32	25	11970			
9.25	+0.25	8.70	9.50	50	3253	23.00	0.52		0.48	0.52	656	21567			
7.28	+0.51	6.85	7.70	111	6443	25.00	0.76	-0.01	0.72	0.76	664	19264			
5.45	-0.12	5.80	5.95	55	6553	27.00	1.12	-0.02	1.09	1.11	491	4142			
3.60	+0.20	3.60	3.70	565	19847	30.00	1.96	-0.10	1.93	1.97	918	21101			
2.46	+0.19	2.44	2.53	860	25952	32.00	2.93	-0.02	2.76	2.82	147	3104			
Last Trade 32.31 as of 02/14/17 4:00 PM ET															
1.20	+0.10	1.21	1.29	488	42290	35.00	5.40	-0.40	4.55	4.65	16	1743			
0.70	+0.06	0.70	0.77	176	6791	37.00	7.00	-0.85	6.00	6.25	10	76			
0.29	+0.04	0.29	0.33	15	6122	40.00	9.35	+0.10	8.55	9.50	24	38			

SOURCE: *The Wall Street Journal* online, February 14, 2017.

TABLE 24.1
A Sample *Wall Street Journal* (Online) Option Quotation for Cisco Systems (CSCO)

The other quotations are similar. The July 95 put option costs \$2.80. If you pay $\$2.80 \times 100 = \280 , then you have the right to sell 100 shares of RWJ stock anytime between now and the third Friday in July at a price of \$95 per share.

Table 24.1 contains a more detailed CBOE quote reproduced from *The Wall Street Journal* (online). The company is Cisco Systems (CSCO). Looking near the center of the table, we see that CSCO is selling for \$32.31 per share. Notice that there are multiple strike prices quoted. As shown, puts and calls with strike prices ranging from 13.00 up to 40.00 are available.

To check your understanding of option quotes, suppose you want the right to sell 100 shares of CSCO for \$30 anytime up until the third Friday in January. What should you do and how much will it cost you?

Because you want the right to sell the stock for \$30, you need to buy a *put* option with a \$30 exercise price. So you go online and place an order for one CSCO January 30 put contract. Because the January 30 put is quoted at \$1.97, you will have to pay \$1.97 per share, or \$197 in all (plus commission).

Of course, you can look up option prices many places on the web. Our nearby *Work the Web* box gives one example. Notice how much more complicated the ticker symbols are for the options compared to the stock.

OPTION PAYOFFS

Looking at Table 24.1, suppose you buy 50 January 30 call contracts. The option is quoted at \$3.70, so the contracts cost \$370 each. You spend a total of $50 \times \$370 = \$18,500$. You wait awhile, and the expiration date rolls around.

Now what? You have the right to buy CSCO stock for \$30 per share. If CSCO is selling for less than \$30 a share, then this option isn't worth anything and you throw it away. In this case, we say that the option has finished "out of the money" because the stock price is less than the exercise price. Your \$18,500 is, alas, a complete loss.

If CSCO is selling for more than \$30 per share, then you need to exercise your option. In this case, the option is "in the money" because the stock price exceeds the exercise price. Suppose CSCO has risen to, say, \$35 per share. Because you have the right to buy CSCO at \$30, you make a \$5 profit on each share upon exercise. Each contract involves 100 shares, so you make \$5 per share \times 100 shares per contract = \$500 per contract. Finally, you own

WORK THE WEB



How do you find option prices for options that are currently traded? To illustrate, we went to finance.yahoo.com, got a stock quote for Southwest Airlines (LUV), and followed the Options link. As you can see below, there were 17 call option contracts trading for Southwest with a January 2019 expiration date.

Calls For January 18, 2019										
Strike	Contract Name	Last Price	Bid	Ask	Change	% Change	Volume	Open Interest	Implied Volatility	
23.00	LUV190118C00023000	25.82	26.60	28.90	0.00	0.00%	2	105	0.00%	
25.00	LUV190118C00025000	24.28	23.10	26.00	0.00	0.00%	20	0	0.00%	
30.00	LUV190118C00030000	18.80	24.30	28.60	0.00	0.00%	2	2	53.06%	
33.00	LUV190118C00033000	22.10	22.70	24.00	0.00	0.00%	16	17	36.35%	
35.00	LUV190118C00035000	15.15	14.50	16.00	0.00	0.00%	2	2	0.00%	
38.00	LUV190118C00038000	16.60	15.40	17.30	0.00	0.00%	5	5	0.00%	
40.00	LUV190118C00040000	16.48	17.40	18.60	0.00	0.00%	1	19	34.44%	
42.00	LUV190118C00042000	11.13	12.10	15.10	0.00	0.00%	1	1	23.76%	
45.00	LUV190118C00045000	15.20	14.10	15.60	0.00	0.00%	3	37	34.90%	
47.00	LUV190118C00047000	12.14	12.80	13.60	0.00	0.00%	10	35	31.45%	
50.00	LUV190118C00050000	11.48	11.10	11.80	1.18	11.46%	18	68	30.73%	
55.00	LUV190118C00055000	8.88	8.60	9.10	0.56	6.73%	26	157	29.46%	
60.00	LUV190118C00060000	7.32	6.30	7.60	0.08	1.10%	1	71	30.81%	
65.00	LUV190118C00065000	5.29	4.90	5.80	-0.08	-1.49%	14	33	29.97%	
70.00	LUV190118C00070000	3.86	3.30	4.30	0.26	7.22%	14	145	29.04%	
75.00	LUV190118C00075000	3.10	2.70	3.20	0.00	0.00%	12	0	28.50%	
80.00	LUV190118C00080000	1.95	1.60	2.35	0.00	0.00%	50	0	28.02%	

The Chicago Board Options Exchange sets the strike prices for traded options. The strike prices are centered around the current stock price, and the number of strike prices depends in part on the trading volume in the stock. One thing you should notice after reading our section on option price boundaries is that a couple of the options appear to be mispriced. For example, the last sale on the \$30 call option was for \$18.80, and the \$33 call's last trade was \$22.10. A call is always more valuable when the strike price decreases, so you would expect the \$30 call to sell for more than the \$33 call. The reason the last prices for the \$30 call and \$33 put appear to be incorrect is because they never occurred at the same time. Options can be very illiquid, and what is happening is that the last price on the \$30 call option is "stale," meaning that it did not occur recently. You may even encounter bid and ask prices on options that don't make sense because the options are so illiquid that none of the market makers have even bothered to update their prices.

Questions

- Look up the options that are currently available for Southwest. What is the expiration date of the longest-term options available? Compare the prices of these long-term options to shorter-term options with the same strike price. What do you find?
- Find the IBM options with the shortest maturity. How many strike prices for IBM options are available? Are there more strike prices available for IBM than Southwest? Why do you think this is?

50 contracts, so the value of your options is a handsome \$25,000. Notice that because you invested \$18,500, your net profit is \$6,500.

As our example indicates, the gains and losses from buying call options can be quite large. To illustrate further, suppose you purchase the stock with the \$18,500 instead of buying call options. In this case, you will have about $\$18,500/\$32.31 = 572.58$ shares. We can now compare what you have when the option expires for different stock prices:

Ending Stock Price	Option Value (50 contracts)	Net Profit or Loss (50 contracts)	Stock Value (572.58 shares)	Net Profit or Loss (572.58 shares)
\$20	\$ 0	-\$18,500	\$ 11,452	-\$7,048
25	0	-18,500	14,314	-4,186
28	0	-18,500	16,032	-2,468
32	10,000	-8,500	18,323	-177
35	25,000	6,500	20,040	1,540
40	50,000	31,500	22,903	4,403

The option position clearly magnifies the gains and losses on the stock by a substantial amount. The reason is that the payoff on your 50 option contracts is based on $50 \times 100 = 5,000$ shares of stock instead of 572.58.

In our example, notice that, if the stock price ends up below the exercise price, then you lose all \$18,500 with the option. With the stock, you still have some portion of your investment as long as the stock price doesn't drop to zero. Also notice that the option can never be worth less than zero because you can always throw it away. As a result, you can never lose more than your original investment (the \$18,500 in our example).

It is important to recognize that stock options are a zero-sum game. By this we mean that whatever the buyer of a stock option makes, the seller loses, and vice versa. To illustrate, suppose, in our preceding example, you *sell* 50 option contracts. You receive \$18,500 up front, and you will be obligated to sell the stock for \$30 if the buyer of the option wishes to exercise it. In this situation, if the stock price ends up below \$30, you will be \$18,500 ahead. If the stock price ends up above \$30, you will have to sell something for less than it is worth, so you will lose the difference. If the stock price is \$35, you will have to sell $50 \times 100 = 5,000$ shares at \$30 per share, so you will be out $\$35 - \$30 = \$5$ per share, or \$25,000 total. Because you received \$18,500 up front, your net loss is \$6,500. We can summarize some other possibilities as follows:

Ending Stock Price	Net Profit to Option Seller
\$20	\$18,500
25	18,500
28	18,500
32	8,500
35	-6,500
40	-31,500

Notice that the net profits to the option buyer (calculated previously) are just the opposites of these amounts.

EXAMPLE 24.1**Put Payoffs**

Looking at Table 24.1, suppose you buy 10 CSCO January 25 put contracts. How much does this cost (ignoring commissions)? Just before the option expires, CSCO is selling for \$21.50 per share. Is this good news or bad news? What is your net profit?

The option is quoted at \$.76, so one contract costs $100 \times .76 = \$76$. Your 10 contracts total \$760. You now have the right to sell 1,000 shares of CSCO for \$25 per share. If the stock is currently selling for \$21.50 per share, then this is most definitely good news. You can buy 1,000 shares at \$21.50 and sell them for \$25. Your puts are worth $\$25 - 21.50 = \3.50 per share, or $\$3.50 \times 1,000 = \$3,500$ in all. Because you paid \$760, your net profit is $\$3,500 - 760 = \$2,740$.

Concept Questions

- 24.1a** What is a call option? A put option?
24.1b If you thought that a stock was going to drop sharply in value, how might you use stock options to profit from the decline?

24.2 Fundamentals of Option Valuation

Now that we understand the basics of puts and calls, we can discuss what determines their values. We will focus on call options in the discussion that follows, but the same type of analysis can be applied to put options.

VALUE OF A CALL OPTION AT EXPIRATION

We have already described the payoffs from call options for different stock prices. In continuing this discussion, the following notation will be useful:

S_1 = Stock price at expiration (in one period)

S_0 = Stock price today

C_1 = Value of the call option on the expiration date (in one period)

C_0 = Value of the call option today

E = Exercise price on the option

From our previous discussion, remember that, if the stock price (S_1) ends up below the exercise price (E) on the expiration date, then the call option (C_1) is worth zero. In other words:

$$C_1 = 0 \quad \text{if } S_1 \leq E$$

Or, equivalently:

$$\mathbf{C_1 = 0 \quad if \; S_1 - E \leq 0}$$

24.1

This is the case in which the option is out of the money when it expires.

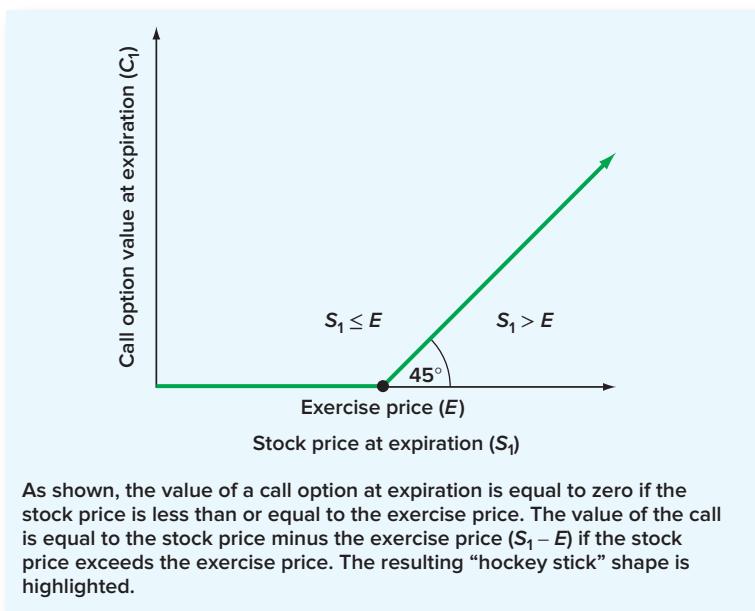
If the option finishes in the money, then $S_1 > E$, and the value of the option at expiration is equal to the difference:

$$C_1 = S_1 - E \quad \text{if } S_1 > E$$

Or, equivalently:

$$\mathbf{C_1 = S_1 - E \quad if \; S_1 - E > 0}$$

24.2



Suppose we have a call option with an exercise price of \$10. The option is about to expire. If the stock is selling for \$8, then we have the right to pay \$10 for something worth only \$8. Our option is worth exactly zero because the stock price is less than the exercise price on the option ($S_1 \leq E$). If the stock is selling for \$12, then the option has value. Because we can buy the stock for \$10, the option is worth $S_1 - E = \$12 - \$10 = \$2$.

Figure 24.1 plots the value of a call option at expiration against the stock price. The result looks something like a hockey stick. Notice that for every stock price less than E , the value of the option is zero. For every stock price greater than E , the value of the call option is $S_1 - E$. Also, once the stock price exceeds the exercise price, the option's value goes up dollar for dollar with the stock price.

THE UPPER AND LOWER BOUNDS ON A CALL OPTION'S VALUE

Now that we know how to determine C_1 , the value of the call at expiration, we turn to a somewhat more challenging question: How can we determine C_0 , the value sometime *before* expiration? We will be discussing this in the next several sections. For now, we will establish the upper and lower bounds for the value of a call option.

The Upper Bound What is the most a call option can sell for? If you think about it, the answer is obvious. A call option gives you the right to buy a share of stock, so it can never be worth more than the stock itself. This tells us the upper bound on a call's value: A call option will always sell for no more than the underlying asset. So, in our notation, the upper bound is:

$$C_0 \leq S_0$$

FIGURE 24.1

Value of a Call Option at Expiration for Different Stock Prices

24.3

The Lower Bound What is the least a call option can sell for? The answer here is a little less obvious. First of all, the call can't sell for less than zero, so $C_0 \geq 0$. Furthermore, if the stock price is greater than the exercise price, the call option is worth at least $S_0 - E$.

To see why, suppose we have a call option selling for \$4. The stock price is \$10, and the exercise price is \$5. Is there a profit opportunity here? The answer is “yes” because you could buy the call for \$4 and immediately exercise it by spending an additional \$5. Your total cost of acquiring the stock would be $\$4 + \$5 = \$9$. If you were to turn around and immediately sell the stock for \$10, you would pocket a \$1 certain profit.

Opportunities for riskless profits such as this one are called *arbitrages* (say “are-arbazhes,” with the accent on the first syllable) or *arbitrage opportunities*. One who arbitrages is called an *arbitrageur*, or “arb” for short. The root for the term *arbitrage* is the same as the root for the word *arbitrate*, and an arbitrageur essentially arbitrates prices. In a well-organized market, significant arbitrages will, of course, be rare.

In the case of a call option, to prevent arbitrage, the value of the call today must be greater than the stock price less the exercise price:

$$C_0 \geq S_0 - E$$

If we put our two conditions together, we have:

$$\begin{aligned} C_0 &\geq 0 & \text{if } S_0 - E < 0 \\ C_0 &\geq S_0 - E & \text{if } S_0 - E \geq 0 \end{aligned}$$

24.4

These conditions say that the lower bound on the call’s value is either zero or $S_0 - E$, whichever is bigger.

Our lower bound is called the **intrinsic value** of the option, and it is what the option would be worth if it were about to expire. With this definition, our discussion thus far can be restated as follows: At expiration, an option is worth its intrinsic value; it will generally be worth more than that anytime before expiration.

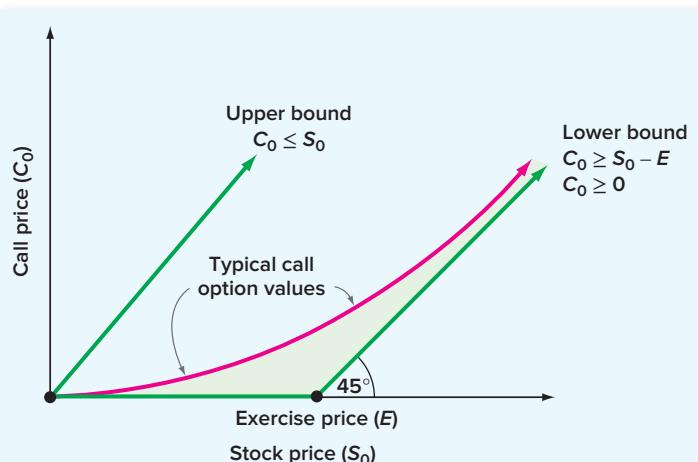
Figure 24.2 displays the upper and lower bounds on the value of a call option. Also plotted is a curve representing typical call option values for different stock prices prior to maturity. The exact shape and location of this curve depend on a number of factors. We begin our discussion of these factors in the next section.

intrinsic value

The lower bound of an option’s value, or what the option would be worth if it were about to expire.

FIGURE 24.2

Value of a Call Option before Expiration for Different Stock Prices



As shown, the upper bound on a call’s value is given by the value of the stock ($C_0 \leq S_0$). The lower bound is either $S_0 - E$ or zero, whichever is larger. The highlighted curve illustrates the value of a call option prior to maturity for different stock prices.

A SIMPLE MODEL: PART I

Option pricing can be a complex subject, and we defer a detailed discussion to a later chapter. Fortunately, as is often the case, many of the key insights can be illustrated with a simple example. Suppose we are looking at a call option with one year to expiration and an exercise price of \$105. The stock currently sells for \$100, and the risk-free rate, R_f , is 20 percent.

The value of the stock in one year is uncertain, of course. To keep things simple, suppose we know that the stock price will be either **\$110** or **\$130**. It is important to note that we *don't* know the odds associated with these two prices. In other words, we know the possible values for the stock, but not the probabilities associated with those values.

Because the exercise price on the option is \$105, we know that the option will be worth either $\$110 - 105 = \5 or $\$130 - 105 = \25 ; but, once again, we don't know which. We do know one thing, however: Our call option is certain to finish in the money.

The Basic Approach Here is the crucial observation: It is possible to exactly duplicate the payoffs on the stock using a combination of the option and the risk-free asset. How? Do the following: Buy one call option and invest \$87.50 in a risk-free asset (such as a T-bill).

What will you have in a year? Your risk-free asset will earn 20 percent, so it will be worth $\$87.50 \times 1.20 = \105 . Your option will be worth **\$5** or **\$25**, so the total value will be either **\$110** or **\$130**, the same as the value of the stock:

Stock Value	vs.	Risk-Free Asset Value	+	Call Value	=	Total Value
\$110		\$105		\$ 5		\$110
130		105		25		130

As illustrated, these two strategies—buying a share of stock or buying a call and investing in the risk-free asset—have exactly the same payoffs in the future.

Because these two strategies have the same future payoffs, they must have the same value today or else there would be an arbitrage opportunity. The stock sells for \$100 today, so the value of the call option today, C_0 , is:

$$\$100 = \$87.50 + C_0$$

$$C_0 = \$12.50$$

Where did we get the \$87.50? This is the present value of the exercise price on the option, calculated at the risk-free rate:

$$E/(1 + R_f) = \$105/1.20 = \$87.50$$

Given this, our example shows that the value of a call option in this simple case is given by:

$$S_0 = C_0 + E/(1 + R_f)$$

$$C_0 = S_0 - E/(1 + R_f)$$

24.5

In words, the value of the call option is equal to the stock price minus the present value of the exercise price.

A More Complicated Case Obviously, our assumption that the stock price in one year will be either \$110 or \$130 is a vast oversimplification. We can now develop a more

realistic model by assuming that the stock price in one year can be *anything* greater than or equal to the exercise price. Once again, we don't know how likely the different possibilities are, but we are certain that the option will finish somewhere in the money.

We again let S_1 stand for the stock price in one year. Now consider our strategy of investing \$87.50 in a riskless asset and buying one call option. The riskless asset will again be worth \$105 in one year, and the option will be worth $S_1 - \$105$, the value of which will depend on the stock price.

When we investigate the combined value of the option and the riskless asset, we observe something very interesting:

$$\begin{aligned}\text{Combined value} &= \text{Riskless asset value} + \text{Option value} \\ &= \$105 + (S_1 - \$105) \\ &= S_1\end{aligned}$$

As we had before, buying a share of stock has exactly the same payoff as buying a call option and investing the present value of the exercise price in the riskless asset.

Once again, to prevent arbitrage, these two strategies must have the same cost, so the value of the call option is equal to the stock price less the present value of the exercise price:²

$$C_0 = S_0 - E/(1 + R_f)$$

Our conclusion from this discussion is that determining the value of a call option is not difficult as long as we are certain that the option will finish somewhere in the money.

FOUR FACTORS DETERMINING OPTION VALUES

If we continue to suppose that our option is certain to finish in the money, then we can readily identify four factors that determine an option's value. There is a fifth factor that comes into play if the option can finish out of the money. We will discuss this last factor in the next section.

For now, if we assume that the option expires in t periods, then the present value of the exercise price is $E/(1 + R_f)^t$, and the value of the call is:

$$\text{Call option value} = \text{Stock value} - \text{Present value of the exercise price}$$

$$C_0 = S_0 - E/(1 + R_f)^t$$

24.6

If we take a look at this expression, we see that the value of the call obviously depends on four factors:

1. *The stock price:* The higher the stock price (S_0) is, the more the call is worth. This comes as no surprise because the option gives us the right to buy the stock at a fixed price.

²You're probably wondering what would happen if the stock price were less than the present value of the exercise price, which would result in a negative value for the call option. This can't happen because we are certain that the stock price will be at least E in one year because we know the option will finish in the money. If the current price of the stock is less than $E/(1 + R_f)$, then the return on the stock is certain to be greater than the risk-free rate, which creates an arbitrage opportunity. For example, if the stock is currently selling for \$80, then the minimum return will be $(\$105 - 80)/\$80 = .3125$, or 31.25%. Because we can borrow at 20 percent, we can earn a certain minimum return of 11.25 percent per dollar borrowed. This, of course, is an arbitrage opportunity.

2. *The exercise price:* The higher the exercise price (E) is, the less the call is worth. This is also not a surprise because the exercise price is what we have to pay to get the stock.
3. *The time to expiration:* The longer the time to expiration (t) is, the more the option is worth. Once again, this is obvious. Because the option gives us the right to buy for a fixed length of time, its value goes up as the length of time increases.
4. *The risk-free rate:* The higher the risk-free rate (R_f) is, the more the call is worth. This result is a little less obvious. Normally, we think of asset values as going down as rates rise. In this case, the exercise price is a cash *outflow*, a liability. The current value of the liability goes down as the discount rate goes up.

Concept Questions

- 24.2a** What is the value of a call option at expiration?
- 24.2b** What are the upper and lower bounds on the value of a call option anytime before expiration?
- 24.2c** Assuming that the stock price is certain to be greater than the exercise price on a call option, what is the value of the call? Why?

Valuing a Call Option

24.3

We now investigate the value of a call option when there is the possibility that the option will finish out of the money. We will again examine the simple case of two possible future stock prices. This case will let us identify the remaining factor that determines an option's value.

A SIMPLE MODEL: PART II

From our previous example, we have a stock that currently sells for \$100. It will be worth either \$110 or \$130 in a year, and we don't know which. The risk-free rate is 20 percent. We are now looking at a different call option, however. This one has an exercise price of \$120 instead of \$105. What is the value of this call option?

This case is a little harder. If the stock ends up at \$110, the option is out of the money and worth nothing. If the stock ends up at \$130, the option is worth $\$130 - \$120 = \$10$.

Our basic approach to determining the value of the call option will be the same. We will show once again that it is possible to combine the call option and a risk-free investment in a way that exactly duplicates the payoff from holding the stock. The only complication is that it's a little harder to determine how to do it.

Suppose we bought one call and invested the present value of the exercise price in a riskless asset as we did before. In one year, we would have \$120 from the riskless investment plus an option worth either zero or \$10. The total value would be either \$120 or \$130. This is not the same as the value of the stock (\$110 or \$130), so the two strategies are not comparable.

Instead, consider investing the present value of \$110 (the lower stock price) in a riskless asset. This guarantees us a \$110 payoff. If the stock price is \$110, then any call options we own are worthless, and we have exactly \$110 as desired.

When the stock is worth \$130, the call option is worth \$10. Our risk-free investment is worth \$110, so we are $\$130 - \$110 = \$20$ short. Because each call option is worth \$10, we need to buy two of them to replicate the value of the stock.

In this case, investing the present value of the lower stock price in a riskless asset and buying two call options exactly duplicates owning the stock. When the stock is worth \$110, we have \$110 from our risk-free investment. When the stock is worth \$130, we have \$110 from the risk-free investment plus two call options worth \$10 each.

Because these two strategies have exactly the same value in the future, they must have the same value today, or arbitrage would be possible:

$$\begin{aligned} S_0 &= \$100 = 2 \times C_0 + \$110/(1 + R_f) \\ 2 \times C_0 &= \$100 - \$110/1.20 \\ C_0 &= \$4.17 \end{aligned}$$

Each call option is worth \$4.17.

EXAMPLE 24.2

Don't Call Us, We'll Call You

We are looking at two call options on the same stock, one with an exercise price of \$20 and one with an exercise price of \$30. The stock currently sells for \$35. Its future price will be either \$25 or \$50. If the risk-free rate is 10 percent, what are the values of these call options?

The first case (with the \$20 exercise price) is not difficult because the option is sure to finish in the money. We know that the value is equal to the stock price less the present value of the exercise price:

$$\begin{aligned} C_0 &= S_0 - E/(1 + R_f) \\ &= \$35 - \$20/1.1 \\ &= \$16.82 \end{aligned}$$

In the second case, the exercise price is \$30, so the option can finish out of the money. At expiration, the option is worth \$0 if the stock is worth \$25. The option is worth $\$50 - \$30 = \$20$ if it finishes in the money.

As before, we start by investing the present value of the lowest stock price in the risk-free asset. This costs $\$25/1.1 = \22.73 . At expiration, we have \$25 from this investment.

If the stock price is \$50, then we need an additional \$25 to duplicate the stock payoff. Because each option is worth \$20 in this case, we need $\$25/\$20 = 1.25$ options. So, to prevent arbitrage, investing the present value of \$25 in a risk-free asset and buying 1.25 call options must have the same value as the stock:

$$\begin{aligned} S_0 &= 1.25 \times C_0 + \$25/(1 + R_f) \\ \$35 &= 1.25 \times C_0 + \$25/(1 + .10) \\ C_0 &= \$9.82 \end{aligned}$$

Notice that this second option had to be worth less because it has the higher exercise price.

THE FIFTH FACTOR

We now illustrate the fifth (and last) factor that determines an option's value. Suppose everything in our example is the same as before except that the stock price can be \$105 or \$135 instead of \$110 or \$130. Notice that the effect of this change is to make the stock's future price more volatile than before.

We investigate the same strategy that we used previously: Invest the present value of the lowest stock price (\$105 in this case) in the risk-free asset and buy two call options. If the stock price is \$105, then, as before, the call options have no value and we have \$105 in all.

If the stock price is \$135, then each option is worth $S_1 - E = \$135 - \$120 = \$15$. We have two calls, so our portfolio is worth $\$105 + 2 \times \$15 = \$135$. Once again, we have exactly replicated the value of the stock.

What has happened to the option's value? More to the point, the variance of the return on the stock has increased. Does the option's value go up or down? To find out, we need to solve for the value of the call just as we did before:

$$\begin{aligned} S_0 &= \$100 = 2 \times C_0 + \$105/(1 + R_f) \\ 2 \times C_0 &= \$100 - \$105/1.20 \\ C_0 &= \$6.25 \end{aligned}$$

The value of the call option has gone up from \$4.17 to \$6.25.

Based on our example, the fifth and final factor that determines an option's value is the variance of the return on the underlying asset. Furthermore, the *greater* that variance is, the *more* the option is worth. This result appears a little odd at first, and it may be somewhat surprising to learn that increasing the risk (as measured by return variance) on the underlying asset increases the value of the option.

The reason that increasing the variance on the underlying asset increases the value of the option isn't hard to see in our example. Changing the lower stock price to \$105 from \$110 doesn't hurt a bit because the option is worth zero in either case. However, moving the upper possible price to \$135 from \$130 makes the option worth more when it is in the money.

More generally, increasing the variance of the possible future prices on the underlying asset doesn't affect the option's value when the option finishes out of the money. The value is always zero in this case. On the other hand, increasing the variance increases the possible payoffs when the option is in the money, so the net effect is to increase the option's value. Put another way, because the downside risk is always limited, the only effect is to increase the upside potential.

In a later discussion, we will use the usual symbol, σ^2 , to stand for the variance of the return on the underlying asset.

A CLOSER LOOK

Before moving on, it will be useful to consider one last example. Suppose the stock price is \$100, and it will move either up or down by 20 percent. The risk-free rate is 5 percent. What is the value of a call option with a \$90 exercise price?

The stock price will be either \$80 or \$120. The option is worth zero when the stock is worth \$80, and it's worth $\$120 - \$90 = \$30$ when the stock is worth \$120. We will invest the present value of \$80 in the risk-free asset and buy some call options.

When the stock finishes at \$120, our risk-free asset pays \$80, leaving us \$40 short. Each option is worth \$30 in this case, so we need $\$40/\$30 = 4/3$ options to match the payoff on the stock. The option's value must be given by:

$$\begin{aligned} S_0 &= \$100 = 4/3 \times C_0 + \$80/1.05 \\ C_0 &= (3/4) \times (\$100 - \$76.19) \\ &= \$17.86 \end{aligned}$$

TABLE 24.2

Five Factors That Determine Option Values

Factor	Direction of Influence	
	Calls	Puts
Current value of the underlying asset	(+)	(-)
Exercise price on the option	(-)	(+)
Time to expiration on the option	(+)	(+)
Risk-free rate	(+)	(-)
Variance of return on the underlying asset	(+)	(+)

To make our result a little bit more general, notice that the number of options that you need to buy to replicate the value of the stock is always equal to $\Delta S/\Delta C$, where ΔS is the difference in the possible stock prices and ΔC is the difference in the possible option values. In our current case, ΔS would be $\$120 - \$80 = \$40$ and ΔC would be $\$30 - \$0 = \$30$, so $\Delta S/\Delta C$ would be $\$40/\$30 = 4/3$, as we calculated.

Notice also that when the stock is certain to finish in the money, $\Delta S/\Delta C$ is always exactly equal to 1, so one call option is always needed. Otherwise, $\Delta S/\Delta C$ is greater than 1, so more than one call option is needed.

This concludes our discussion of option valuation. The most important thing to remember is that the value of an option depends on five factors. Table 24.2 summarizes these factors and the direction of their influence for both puts and calls. In Table 24.2, the sign in parentheses indicates the direction of the influence.³ In other words, the sign tells us whether the value of the option goes up or down when the value of a factor increases. Notice that increasing the exercise price reduces the value of a call option. Increasing any of the other four factors increases the value of the call. Notice also that the time to expiration and the variance of return act the same for puts and calls. The other three factors have opposite signs in the two cases.

We have not considered how to value a call option when the option can finish out of the money and the stock price can take on more than two values. A very famous result, the Black-Scholes option pricing model, is needed in this case. We cover this subject in detail in Chapter 25.

Concept Questions

- 24.3a** What are the five factors that determine an option's value?
- 24.3b** What is the effect of an increase in each of the five factors on the value of a call option? Give an intuitive explanation for your answer.
- 24.3c** What is the effect of an increase in each of the five factors on the value of a put option? Give an intuitive explanation for your answer.

24.4 Employee Stock Options

employee stock option (ESO)

An option granted to an employee by a company giving the employee the right to buy shares of stock in the company at a fixed price for a fixed time.

Options are important in corporate finance in a lot of different ways. In this section, we begin to examine some of these by taking a look at **employee stock options**, or ESOs. An ESO is, in essence, a call option that a firm grants to employees giving them the right to buy shares of stock in the company. The practice of granting options to employees has become widespread. It is almost universal for upper management; but some companies, like

³The signs in Table 24.2 are for American options. For a European put option, the effect of increasing the time to expiration is ambiguous, and the direction of the influence can be positive or negative.

The Gap and Starbucks, grant options to almost every employee. Thus, an understanding of ESOs is important. Why? Because you may soon be an ESO holder!

ESO FEATURES

Because ESOs are basically call options, we have already covered most of the important aspects. However, ESOs have a few features that make them different from regular stock options. The details differ from company to company, but a typical ESO has a 10-year life, which is much longer than most ordinary options. Unlike traded options, ESOs cannot be sold. They also have what is known as a “vesting” period: Often, for up to three years or so, an ESO cannot be exercised and also must be forfeited if an employee leaves the company. After this period, the options “vest,” which means they can be exercised. Sometimes, employees who resign with vested options are given a limited time to exercise their options.

Why are ESOs granted? There are basically two reasons. First, going back to Chapter 1, the owners of a corporation (the shareholders) face the basic problem of aligning shareholder and management interests and also of providing incentives for employees to focus on corporate goals. ESOs are a powerful motivator because, as we have seen, the payoffs on options can be very large. High-level executives in particular stand to gain enormous wealth if they are successful in creating value for stockholders.

The second reason some companies rely heavily on ESOs is that an ESO has no immediate, up-front, out-of-pocket cost to the corporation. In smaller, possibly cash-strapped companies, ESOs are a substitute for ordinary wages. Employees are willing to accept them instead of cash, hoping for big payoffs in the future. In fact, ESOs are a major recruiting tool, allowing businesses to attract talent that they otherwise could not afford.



See www.esopassociation.org for a site devoted to employee stock options.

ESO REPRICING

ESOs are almost always “at-the-money” when they are issued, meaning that the stock price is equal to the strike price. Notice that, in this case, the intrinsic value is zero, so there is no value from immediate exercise. Of course, even though the intrinsic value is zero, an ESO is still quite valuable because of, among other things, its very long life.

If the stock falls significantly after an ESO is granted, then the option is said to be “underwater.” On occasion, a company will decide to lower the strike price on underwater options. Such options are said to be “restruck” or “repriced.”

The practice of repricing ESOs is controversial. Companies that do it argue that once an ESO becomes deeply out of the money, it loses its incentive value because employees recognize there is only a small chance that the option will finish in the money. In fact, employees may leave and join other companies where they receive a fresh options grant.

Critics of repricing point out that a lowered strike price is, in essence, a reward for failing. They also point out that if employees know that options will be repriced, then much of the incentive effect is lost. Because of this controversy, many companies do not reprice options or have voted against repricing. For example, pharmaceutical giant Bristol-Myers Squibb’s explicit policy prohibiting option repricing states, “It is the board of directors’ policy that the company will not, without stockholder approval, amend any employee or nonemployee director stock option to reduce the exercise price (except for appropriate adjustment in the case of a stock split or similar change in capitalization).” However, other equally well-known companies have no such policy, and some have been labeled “serial repricers.” The accusation is that such companies routinely drop strike prices following stock price declines.

An option exchange is a variation on a repricing. What typically happens is that underwater ESOs are exchanged for a smaller number of new ESOs with a lower exercise price, although this is not always the case. For example, in 2016, content processing solutions company Top Image Systems exchanged 377,275 options held by employees for new options at



For more information about ESOs, try the National Center for Employee Ownership at www.nceo.org.

IN THEIR OWN WORDS ...

Erik Lie on Option Backdating

Stock options can be granted to executive and other employees as an incentive device. They strengthen the relation between compensation and a firm's stock price performance, thus boosting effort and improving decision making within the firm. Further, to the extent that decision makers are risk averse (as most of us are), options induce more risk taking, which can benefit shareholders. However, options also have a dark side. They can be used to (i) conceal true compensation expenses in financial reports, (ii) evade corporate taxes, and (iii) siphon money from corporations to executives. One example that illustrates all three of these aspects is that of option backdating.

To understand the virtue of option backdating, it is first important to realize that for accounting, tax, and incentive reasons, most options are granted at-the-money, meaning that their exercise price equals the stock price on the grant date. Option backdating is the practice of selecting a past date (e.g., from the past month) when the stock price was particularly low to be the official grant date. This raises the value of the options, because they are effectively granted in-the-money. Unless this is properly disclosed and accounted for (which it rarely is), the practice of backdating can cause an array of problems. First, granting options that are effectively in-the-money violates many corporate option plans or other securities filings stating that the exercise price equals the fair market value on the grant day. Second, camouflaging in-the-money options as at-the-money options understates compensation expenses in the financial statements. In fact, under the old accounting rule APB 25 that was phased out in 2005, companies could expense options according to their intrinsic value, such that at-the-money options were not expensed at all. Third, at-the-money option grants qualify for certain tax breaks that in-the-money option grants do not qualify for, such that backdating can result in underpaid taxes.

Empirical evidence shows that the practice of backdating was prevalent from the early 1990s to 2005, especially among tech firms. As this came to the attention of the media and regulators in 2006, a scandal erupted. More than 100 companies were investigated for manipulation of option grant dates. As a result, numerous executives were fired, old financial statements were restated, additional taxes became due, and countless lawsuits were filed against companies and their directors. With new disclosure rules, stricter enforcement of the requirement that took effect as part of the Sarbanes-Oxley Act in 2002 that grants have to be filed within two business days, and greater scrutiny by regulators and the investment community, we likely have put the practice of backdating options behind us.

Erik Lie is a Henry B. Tippie Research Professor of Finance at the University of Iowa. His research focuses on corporate financial policy, M&A, and executive compensation.

a lower strike price of \$2.11. Interestingly, the company stated that options for 79,166 shares held by the CEO and two board members would not be repriced unless the repricing was approved by shareholders. Frequently, option exchanges are structured such that the value of the new options is approximately equal to that of the old ones. In essence, a large number of underwater options are exchanged for a smaller number of at-the-money options.

Today, many companies award options on a regular basis, perhaps annually or even quarterly. That way, an employee will always have at least some options that are near the money even if others are underwater. Also, regular grants ensure that employees always have unvested options, which gives them an added incentive to stay with their current employer rather than forfeit the potentially valuable options.

ESO BACKDATING

A scandal erupted in 2006 over the backdating of ESOs. Recall that ESOs are almost always at the money on the grant date, meaning that the strike price is set equal to the stock price on the grant date. Financial researchers discovered that many companies had a practice of looking backward in time to select the grant date. Why did they do this? The answer is that they would pick a date on which the stock price (looking back) was low, thereby leading to option grants with low strike prices relative to the current stock price.

Backdating ESOs is not necessarily illegal or unethical as long as there is full disclosure and various tax and accounting issues are handled properly. Before the Sarbanes-Oxley Act of 2002 (which we discussed in Chapter 1), companies had up to 45 days after the end of

their fiscal years to report options grants, so there was ample leeway for backdating. Because of Sarbanes-Oxley, companies are now required to report option grants within two business days of the grant dates, thereby limiting the gains from any backdating.

Concept Questions

24.4a What are the key differences between a traded stock option and an ESO?

24.4b What is ESO repricing? Why is it controversial?

Equity as a Call Option on the Firm's Assets

24.5

Now that we understand the basic determinants of an option's value, we turn to examining some of the many ways that options appear in corporate finance. One of the most important insights we gain from studying options is that the common stock in a leveraged firm (one that has issued debt) is effectively a call option on the assets of the firm. This is a remarkable observation, and we explore it next.

Looking at an example is the easiest way to get started. Suppose a firm has a single debt issue outstanding. The face value is \$1,000, and the debt is coming due in a year. There are no coupon payments between now and then, so the debt is effectively a pure discount bond. In addition, the current market value of the firm's assets is \$980, and the risk-free rate is 12.5 percent.

In a year, the stockholders will have a choice. They can pay off the debt for \$1,000 and thereby acquire the assets of the firm free and clear, or they can default on the debt. If they default, the bondholders will own the assets of the firm.

In this situation, the stockholders essentially have a call option on the assets of the firm with an exercise price of \$1,000. They can exercise the option by paying the \$1,000, or they can choose not to exercise the option by defaulting. Whether or not they will choose to exercise obviously depends on the value of the firm's assets when the debt becomes due.

If the value of the firm's assets exceeds \$1,000, then the option is in the money, and the stockholders will exercise by paying off the debt. If the value of the firm's assets is less than \$1,000, then the option is out of the money, and the stockholders will optimally choose to default. What we now illustrate is that we can determine the values of the debt and equity using our option pricing results.

CASE I: THE DEBT IS RISK-FREE

Suppose that in one year the firm's assets will be worth either \$1,100 or \$1,200. What is the value today of the equity in the firm? The value of the debt? What is the interest rate on the debt?

To answer these questions, we first recognize that the option (the equity in the firm) is certain to finish in the money because the value of the firm's assets (\$1,100 or \$1,200) will always exceed the face value of the debt. In this case, from our discussion in previous sections, we know that the option value is the difference between the value of the underlying asset and the present value of the exercise price (calculated at the risk-free rate). The present value of \$1,000 in one year at 12.5 percent is \$888.89. The current value of the firm is \$980, so the option (the firm's equity) is worth $\$980 - \$888.89 = \$91.11$.

What we see is that the equity, which is effectively an option to purchase the firm's assets, must be worth \$91.11. The debt must actually be worth \$888.89. In fact, we really didn't need to know about options to handle this example because the debt is risk-free. The reason is that the bondholders are certain to receive \$1,000. Because the debt is risk-free,

IN THEIR OWN WORDS ...

Robert C. Merton on Applications of Options Analysis

Organized markets for trading options on stocks, fixed-income securities, currencies, financial futures, and a variety of commodities are among the most successful financial innovations of the past generation. Commercial success is not, however, the reason that option pricing analysis has become one of the cornerstones of finance theory. Instead, its central role derives from the fact that optionlike structures permeate virtually every part of the field.

From the first observation 40 years ago that leveraged equity has the same payoff structure as a call option, option pricing theory has provided an integrated approach to the pricing of corporate liabilities, including all types of debt, preferred stocks, warrants, and rights. The same methodology has been applied to the pricing of pension fund insurance, deposit insurance, and other government loan guarantees. It has also been used to evaluate various labor contract provisions such as wage floors and guaranteed employment, including tenure.

A significant and recent extension of options analysis has been to the evaluation of operating or “real” options in capital budgeting decisions. For example, a facility that can use various inputs to produce various outputs provides the firm with operating options not available from a specialized facility that uses a fixed set of inputs to produce a single type of output. Similarly, choosing among technologies with different proportions of fixed and variable costs can be viewed as evaluating alternative options to change production levels, including abandonment of the project. Research and development projects are essentially options to either establish new markets, expand market share, or reduce production costs. As these examples suggest, options analysis is especially well suited to the task of evaluating the “flexibility” components of projects. These are precisely the components whose values are particularly difficult to estimate by using traditional capital budgeting techniques.

Robert C. Merton is the School of Management Distinguished Professor of Finance at the MIT Sloan School of Management and Professor Emeritus at Harvard University. He received the 1997 Nobel Prize in Economics for his work on pricing options and other contingent claims and for his work on risk and uncertainty.

the appropriate discount rate (and the interest rate on the debt) is the risk-free rate, and we know immediately that the current value of the debt is $\$1,000/1.125 = \888.89 . The equity is worth $\$980 - 888.89 = \91.11 , as we calculated.

CASE II: THE DEBT IS RISKY

Suppose now that the value of the firm’s assets in one year will be either \$800 or \$1,200. This case is a little more difficult because the debt is no longer risk-free. If the value of the assets turns out to be \$800, then the stockholders will not exercise their option and will thereby default. The stock is worth nothing in this case. If the assets are worth \$1,200, then the stockholders will exercise their option to pay off the debt and will enjoy a profit of $\$1,200 - 1,000 = \200 .

What we see is that the option (the equity in the firm) will be worth either zero or \$200. The assets will be worth either \$1,200 or \$800. Based on our discussion in previous sections, a portfolio that has the present value of \$800 invested in a risk-free asset and $(\$1,200 - 800)/(\$200 - 0) = 2$ call options exactly replicates the value of the assets of the firm.

The present value of \$800 at the risk-free rate of 12.5 percent is $\$800/1.125 = \711.11 . This amount, plus the value of the two call options, is equal to \$980, the current value of the firm:

$$\begin{aligned} \$980 &= 2 \times C_0 + \$711.11 \\ C_0 &= \$134.44 \end{aligned}$$

Because the call option in this case is actually the firm’s equity, the value of the equity is \$134.44. The value of the debt is $\$980 - 134.44 = \845.56 .

Finally, because the debt has a \$1,000 face value and a current value of \$845.56, the interest rate is $(\$1,000/\$845.56) - 1 = .1827$, or 18.27%. This exceeds the risk-free rate, of course, because the debt is now risky.

Equity as a Call Option**EXAMPLE 24.3**

Swenson Software has a pure discount debt issue with a face value of \$100. The issue is due in one year. At that time, the assets of the firm will be worth either \$55 or \$160, depending on the sales success of Swenson's latest product. The assets of the firm are currently worth \$110. If the risk-free rate is 10 percent, what is the value of the equity in Swenson? The value of the debt? The interest rate on the debt?

To replicate the value of the assets of the firm, we first need to invest the present value of \$55 in the risk-free asset. This costs $\$55/1.10 = \50 . If the assets turn out to be worth \$160, then the option is worth $\$160 - 100 = \60 . Our risk-free asset will be worth \$55, so we need $(\$160 - 55)/\$60 = 1.75$ call options. Because the firm is currently worth \$110, we have:

$$\begin{aligned} \$110 &= 1.75 \times C_0 + \$50 \\ C_0 &= \$34.29 \end{aligned}$$

The equity is worth \$34.29; the debt is worth $\$110 - 34.29 = \75.71 . The interest rate on the debt is about $(\$100/\$75.71) - 1 = .321$, or 32.1%.

Concept Questions

- 24.5a** Why do we say that the equity in a leveraged firm is effectively a call option on the firm's assets?
- 24.5b** All other things being the same, would the stockholders of a firm prefer to increase or decrease the volatility of the firm's return on assets? Why? What about the bondholders? Give an intuitive explanation.

Options and Capital Budgeting

Most of the options we have discussed so far are financial options because they involve the right to buy or sell financial assets such as shares of stock. In contrast, **real options** involve real assets. As we will discuss in this section, our understanding of capital budgeting can be greatly enhanced by recognizing that many corporate investment decisions really amount to the evaluation of real options.

To give a simple example of a real option, imagine that you are shopping for a used car. You find one that you like for \$4,000, but you are not completely sure. So, you give the owner of the car \$150 to hold the car for you for one week, meaning that you have one week to buy the car or else you forfeit your \$150. As you probably recognize, what you have done here is to purchase a call option, giving you the right to buy the car at a fixed price for a fixed time. It's a real option because the underlying asset (the car) is a real asset.

The use of options such as the one in our car example is common in the business world. For example, real estate developers frequently need to purchase several smaller tracts of land from different owners to assemble a single larger tract. The development can't go forward unless all of the smaller properties are obtained. In this case, the developer will often buy options on the individual properties but will exercise those options only if all of the necessary pieces can be obtained.

These examples involve explicit options. As it turns out, almost all capital budgeting decisions contain numerous *implicit* options. We discuss the most important types of these next.

24.6

real option

An option that involves real assets as opposed to financial assets such as shares of stock.

THE INVESTMENT TIMING DECISION

Consider a business that is examining a new project of some sort. What this normally means is management must decide whether to make an investment outlay to acquire the new assets needed for the project. If you think about it, what management has is the right, but not the obligation, to pay some fixed amount (the initial investment) and thereby acquire a real asset (the project). In other words, essentially all proposed projects are real options!

Based on our discussion in previous chapters, you already know how to analyze proposed business investments. You would identify and analyze the relevant cash flows and assess the net present value (NPV) of the proposal. If the NPV is positive, you would recommend taking the project, where taking the project amounts to exercising the option.

There is a very important qualification to this discussion that involves mutually exclusive investments. Remember that two (or more) investments are said to be mutually exclusive if we can take only one of them. A standard example is a situation in which we own a piece of land that we wish to build on. We are considering building either a gasoline station or an apartment building. We further think that both projects have positive NPVs, but, of course, we can take only one. Which one do we take? The obvious answer is that we take the one with the larger NPV.

Here is the key point: Just because an investment has a positive NPV doesn't mean we should take it today. That sounds like a complete contradiction of what we have said all along, but it isn't. The reason is that if we take a project today, we can't take it later. Put differently, almost all projects compete with themselves in time. We can take a project now, a month from now, a year from now, and so on. We therefore have to compare the NPV of taking the project now versus the NPV of taking it later. Deciding when to take a project is called the **investment timing decision**.

A simple example is useful to illustrate the investment timing decision. A project costs \$100 and has a single future cash flow. If we take it today, the cash flow will be \$120 in one year. If we wait one year, the project will still cost \$100, but the cash flow the following year (two years from now) will be \$130 because the potential market is bigger. If these are the only two options, and the relevant discount rate is 10 percent, what should we do?

To answer this question, we need to compute the two NPVs. If we take it today, the NPV is:

$$\text{NPV} = -\$100 + \$120/1.1 = \$9.09$$

If we wait one year, the NPV at that time will be:

$$\text{NPV} = -\$100 + \$130/1.1 = \$18.18$$

This \$18.18 is the NPV one year from now. We need the value today, so we discount back one period:

$$\text{NPV} = \$18.18/1.1 = \$16.53$$

So, the choice is clear. If we wait, the NPV is \$16.53 today compared to \$9.09 if we start immediately, so the optimal time to begin the project is one year from now.

The fact that we do not have to take a project immediately is often called the "option to wait." In our simple example, the value of the option to wait is the difference in NPVs: $\$16.53 - 9.09 = \7.44 . This \$7.44 is the extra value created by deferring the start of the project as opposed to taking it today.

As our example illustrates, the option to wait can be valuable. How valuable depends on the type of project. If we were thinking about a consumer product intended to capitalize on a current fashion or trend, then the option to wait is probably not very valuable because the window of opportunity is probably short. In contrast, suppose the project in question

investment timing decision

The evaluation of the optimal time to begin a project.

is a proposal to replace an existing production facility with a new, higher-efficiency one. This type of investment can be made now or later. In this case, the option to wait may be valuable.

The Investment Timing Decision

EXAMPLE 24.4

A project costs \$200 and has a future cash flow of \$42 per year forever. If we wait one year, the project will cost \$240 because of inflation, but the cash flows will be \$48 per year forever. If these are the only two options, and the relevant discount rate is 12 percent, what should we do? What is the value of the option to wait?

In this case, the project is a simple perpetuity. If we take it today, the NPV is:

$$NPV = -\$200 + \$42/.12 = \$150$$

If we wait one year, the NPV at that time will be:

$$NPV = -\$240 + \$48/.12 = \$160$$

So, \$160 is the NPV one year from now, but we need to know the value today. Discounting back one period, we get:

$$NPV = \$160/1.12 = \$142.86$$

If we wait, the NPV is \$142.86 today compared to \$150 if we start immediately, so the optimal time to begin the project is now.

What's the value of the option to wait? It is tempting to say that it is $\$142.86 - 150 = -\714 , but that's wrong. Why? Because, as we discussed earlier, an option can never have a negative value. In this case, the option to wait has a zero value.

There is another important aspect regarding the option to wait. Just because a project has a negative NPV today doesn't mean that we should permanently reject it. Suppose an investment costs \$120 and has a perpetual cash flow of \$10 per year. If the discount rate is 10 percent, then the NPV is $\$10/.10 - \$120 = -\$20$, so the project should not be taken now.

We should not just forget about this project forever, though. Suppose that next year, for some reason, the relevant discount rate falls to 5 percent. Then the NPV would be $\$10/.05 - \$120 = \$80$, and we would take the project (assuming that further waiting isn't even more valuable). More generally, as long as there is some possible future scenario under which a project has a positive NPV, then the option to wait is valuable, and we should just shelve the project proposal for now.

MANAGERIAL OPTIONS

Once we decide the optimal time to launch a project, other real options come into play. In our capital budgeting analysis thus far, we have more or less ignored the impact of managerial actions that might take place *after* a project is launched. In effect, we assumed that, once a project is launched, its basic features cannot be changed.

In reality, depending on what actually happens in the future, there will always be opportunities to modify a project. These opportunities, which are an important type of real option, are often called **managerial options**. There are a great number of these options. The ways in which a product is priced, manufactured, advertised, and produced can all be changed, and these are just a few of the possibilities.

For example, in 2008, faced with dramatically higher fuel costs, US Airways announced major changes in its operations. First, the company decided to cut domestic capacity by

managerial options

Opportunities that managers can exploit if certain things happen in the future.

6 to 8 percent in the fourth quarter of 2008 and an additional 7 to 9 percent in 2009. It also planned to return 10 jetliners to lessors by 2009, and it canceled the leases on two wide-body jets originally scheduled for its fleet in 2009. Further fleet reductions were to occur in 2010.

US Airways also planned to eliminate 1,700 jobs through attrition, voluntary leaves of absence, and furloughs. The biggest job cuts would be in Las Vegas, where 600 jobs would be lost. The company's intention was to cut the number of destinations served from Las Vegas from 55 to 31 and to reduce the number of daily flights to that city from 141 to 81.

Finally, US Airways announced increases in fees. It would begin charging \$15 for a passenger's first checked bag, which was later raised to \$25 for the first bag and \$35 for the second bag. There would be a \$2 charge for nonalcoholic beverages on domestic flights, and the cost of alcoholic beverages would rise from \$5 to \$7. The company also planned to charge \$25 for mileage-award tickets and to increase fees for tickets purchased through its reservations line.

Contingency Planning The various what-if procedures, particularly the break-even measures we discussed in an earlier chapter, have a use beyond that of evaluating cash flow and NPV estimates. We can also view these procedures and measures as primitive ways of exploring the dynamics of a project and investigating managerial options. What we think about in this case are some of the possible futures that could come about and what actions we might take if they do.

We might find that a project fails to break even when sales drop below 10,000 units. This is a fact that is interesting to know; but the more important thing is to then go on and ask: What actions are we going to take if this actually occurs? This is called **contingency planning**, and it amounts to an investigation of some of the managerial options implicit in a project.

There is no limit to the number of possible futures or contingencies we could investigate. However, there are some broad classes, and we consider these next.

The Option to Expand One particularly important option we have not explicitly addressed is the option to expand. If we truly find a positive NPV project, then there is an obvious consideration. Can we expand the project or repeat it to get an even larger NPV? Our static analysis implicitly assumes that the scale of the project is fixed.

If the sales demand for a particular product were to greatly exceed expectations, then we might investigate increasing production. If this is not feasible for some reason, then we could always increase cash flow by raising the price. Either way, the potential cash flow is higher than we have indicated because we have implicitly assumed that no expansion or price increase is possible. Overall, because we ignore the option to expand in our analysis, we *underestimate* NPV (all other things being equal).

The Option to Abandon At the other extreme, the option to scale back or even abandon a project is also quite valuable. If a project does not break even on a cash flow basis, then it can't even cover its own expenses. We would be better off if we just abandoned it. Our discounted cash flow (DCF) analysis implicitly assumes that we would keep operating even in this case.

Sometimes, the best thing to do is punt. For example, in 2016, Adidas and Nike admitted to a shank when they announced that they were exiting the golf equipment business. Also in 2016, golf retailer Golfsmith announced that it was selling off Golf Town, its Canadian operations. Later in the year, Golfsmith sold off the remaining U.S. assets to Dick's Sporting Goods and a group of liquidators.

contingency planning

Taking into account the managerial options implicit in a project.

More generally, if sales demand is significantly below expectations, we might be able to sell off some capacity or put it to another use. Maybe the product or service could be redesigned or otherwise improved. Regardless of the specifics, we once again *underestimate* NPV if we assume that the project must last for some fixed number of years, no matter what happens in the future.

The Option to Suspend or Contract Operations An option that is closely related to the option to abandon is the option to suspend operations. Frequently, we see companies choosing to temporarily shut down an activity of some sort. For example, automobile manufacturers sometimes find themselves with too many vehicles of a particular type. In this case, production is often halted until the excess supply is sold. At some point in the future, production resumes.

The option to suspend operations is particularly valuable in natural resource extraction. Suppose you own a gold mine. If gold prices fall dramatically, then your analysis might show that it costs more to extract an ounce of gold than you can sell the gold for, so you quit mining. The gold just stays in the ground and you can always resume operations if the price rises sufficiently. In fact, operations might be suspended and restarted many times over the life of the mine.

Companies also sometimes choose to permanently scale back an activity. If a new product does not sell as well as planned, production might be cut back and the excess capacity put to some other use. This case is really just the opposite of the option to expand, so we will label it the option to contract.

For example, in 2013, Ford faced tremendous pressure from political and union leaders in Belgium when the company closed its plant in Genk. Ford planned to move production to other plants in Europe. Some estimate that plants in Europe can produce seven to eight million more cars and light trucks than the market can absorb.

Options in Capital Budgeting: An Example Suppose we are examining a new project. To keep things relatively simple, let's say that we expect to sell 100 units per year at \$1 net cash flow apiece into perpetuity. Thus, we expect that the cash flow will be \$100 per year.

In one year, we will know more about the project. In particular, we will have a better idea of whether it is successful. If it looks like a long-term success, the expected sales will be revised upward to 150 units per year. If it does not, the expected sales will be revised downward to 50 units per year. Success and failure are equally likely. Notice that because there is an even chance of selling 50 or 150 units, the expected sales are still 100 units, as we originally projected. The cost is \$550, and the discount rate is 20 percent. The project can be dismantled and sold in one year for \$400 if we decide to abandon it. Should we take it?

A standard DCF analysis is not difficult. The expected cash flow is \$100 per year forever, and the discount rate is 20 percent. The PV of the cash flows is $\$100/.20 = \500 , so the NPV is $\$500 - 550 = -\50 . We shouldn't take the project.

This analysis ignores valuable options. In one year, we can sell for \$400. How can we account for this? We have to decide what we are going to do one year from now. In this simple case, we need to evaluate only two contingencies, an upward revision and a downward revision, so not much extra work is needed.

In one year, if the expected cash flows are revised to \$50, then the PV of the cash flows is revised downward to $\$50/.20 = \250 . We get \$400 by abandoning the project, so that is what we will do (in one year, the NPV of keeping the project is $\$250 - 400 = -\150).

If the demand is revised upward, then the PV of the future cash flows at Year 1 is $\$150/.20 = \750 . This exceeds the \$400 abandonment value, so we will keep the project.

We have a project that costs \$550 today. In one year, we expect a cash flow of \$100 from the project. In addition, this project will be worth either \$400 (if we abandon it because it is a failure) or \$750 (if we keep it because it succeeds). These outcomes are equally likely, so we expect the project to be worth $(\$400 + 750)/2$, or \$575.

Summing up, in one year, we expect to have \$100 in cash plus a project worth \$575, or \$675 total. At a 20 percent discount rate, this \$675 is worth \$562.50 today, so the NPV is $\$562.50 - 550 = \12.50 . We should take the project.

The NPV of our project has increased by \$62.50. Where did this come from? Our original analysis implicitly assumed we would keep the project even if it was a failure. At Year 1, however, we saw that we were \$150 better off (\$400 versus \$250) if we abandoned. There was a 50 percent chance of this happening, so the expected gain from abandoning is \$75. The PV of this amount is the value of the option to abandon: $\$75/1.20 = \62.50 .

strategic options

Options for future, related business products or strategies.

Strategic Options Companies sometimes undertake new projects just to explore possibilities and evaluate potential future business strategies. This is a little like testing the water by sticking a toe in before diving. Such projects are difficult to analyze using conventional DCF methods because most of the benefits come in the form of **strategic options**—that is, options for future, related business moves. Projects that create such options may be very valuable, but that value is difficult to measure. Research and development is an example of a strategic option that is an important and valuable activity for many firms, precisely because it creates options for new products and procedures.

To give another example, a large manufacturer might decide to open a retail outlet as a pilot study. The primary goal is to gain some market insight. Because of the high start-up costs, this one operation won't break even. However, using the sales experience gained from the pilot, the firm can then evaluate whether to open more outlets, to change the product mix, to enter new markets, and so on. The information gained and the resulting options for actions are all valuable, but coming up with a reliable dollar figure is probably infeasible.

Conclusion We have seen that incorporating options into capital budgeting analysis is not easy. What can we do about them in practice? The answer is that we need to keep them in mind as we work with the projected cash flows. We will tend to underestimate NPV by ignoring options. The damage might be small for a highly structured, very specific proposal, but it might be great for an exploratory one.

Concept Questions

24.6a Why do we say that almost every capital budgeting proposal involves mutually exclusive alternatives?

24.6b What are the options to expand, abandon, and suspend operations?

24.6c What are strategic options?

24.7 Options and Corporate Securities

In this section, we return to financial assets by considering some of the most common ways options appear in corporate securities and other financial assets. We begin by examining warrants and convertible bonds.

WARRANTS

A **warrant** is a corporate security that looks a lot like a call option. It gives the holder the right, but not the obligation, to buy shares of common stock directly from a company at a fixed price for a given time period. Each warrant specifies the number of shares of stock the holder can buy, the exercise price, and the expiration date.

The differences in contractual features between the call options that trade on the Chicago Board Options Exchange and warrants are relatively minor. Warrants usually have much longer maturity periods. In fact, some warrants are actually perpetual and have no fixed expiration date.

Warrants are sometimes called *sweeteners* or *equity kickers* because they are often issued in combination with privately placed loans or bonds. Throwing in some warrants is a way of making the deal a little more attractive to the lender, and it is a common practice. Warrants have been listed and traded on the NYSE since April 13, 1970. In early 2017, there were only 20 warrants listed on the NYSE. In Europe, warrants are still popular. Also in early 2017, Euronext listed about 57,000 of them.

In many cases, warrants are attached to bonds when issued. The loan agreement will state whether the warrants are detachable from the bond. Usually, the warrant can be detached immediately and sold by the holder as a separate security.

The Difference between Warrants and Call Options As we have explained, from the holder's point of view, warrants are similar to call options on common stock. A warrant, like a call option, gives its holder the right to buy common stock at a specified price. From the firm's point of view, a warrant is different from a call option sold on the company's common stock.

The most important difference between call options and warrants is that call options are issued by individuals and warrants are issued by firms. When a call option is exercised, one investor buys stock from another investor. The company is not involved. When a warrant is exercised, the firm must issue new shares of stock. Each time a warrant is exercised, then, the firm receives some cash and the number of shares outstanding increases. Notice that the employee stock options we discussed earlier in the chapter are issued by corporations; so, strictly speaking, they are warrants rather than options.

To illustrate, suppose the Endrun Company issues a warrant giving holders the right to buy one share of common stock at \$25. Further suppose the warrant is exercised. Endrun must print one new stock certificate. In exchange for the stock certificate, it receives \$25 from the holder.

In contrast, when a call option is exercised, there is no change in the number of shares outstanding. Suppose Ms. Enger purchases a call option on the common stock of the Endrun Company from Mr. Swift. The call option gives Ms. Enger the right to buy (from Mr. Swift) one share of common stock of the Endrun Company for \$25.

If Ms. Enger chooses to exercise the call option, then Mr. Swift is obligated to give her one share of Endrun's common stock in exchange for \$25. If Mr. Swift does not already own a share, he must go into the stock market and buy one.

The call option amounts to a side bet between Ms. Enger and Mr. Swift on the value of the Endrun Company's common stock. When a call option is exercised, one investor gains and the other loses. The total number of shares outstanding of the Endrun Company remains constant, and no new funds are made available to the company.

Earnings Dilution Warrants (and convertible bonds, as we will see) frequently cause the number of shares to increase. This happens (1) when the warrants are exercised and (2) when the bonds are converted, causing the firm's net income to be spread over a larger number of shares. Earnings per share therefore decrease.

warrant

A security that gives the holder the right to purchase shares of stock at a fixed price over a given period of time.

Firms with significant numbers of warrants and convertible issues outstanding will generally calculate and report earnings per share on a *diluted basis*. This means that the calculation is based on the number of shares that would be outstanding if all the warrants were exercised and all the convertibles were converted. Because this increases the number of shares, diluted EPS will be lower than “basic” EPS, which is calculated only on the basis of shares actually outstanding.

Convertible Bonds

convertible bond

A bond that can be exchanged for a fixed number of shares of stock for a specified amount of time.

A **convertible bond** is similar to a bond with warrants. The most important difference is that a bond with warrants can be separated into distinct securities (a bond and some warrants), but a convertible bond cannot. A convertible bond gives the holder the right to exchange the bond for a fixed number of shares of stock anytime up to and including the maturity date of the bond.

Preferred stock can frequently be converted into common stock. A convertible preferred stock is the same as a convertible bond except that it has an infinite maturity date.⁴

Features of a Convertible Bond We can illustrate the basic features of a convertible bond by examining a particular issue. In March 2014, electric car manufacturer Tesla issued \$1.2 billion in convertible bonds. The bonds have a 1.25 percent coupon rate, mature in 2021, and can be converted into Tesla common stock at a **conversion price** of \$359.87. Because each bond has a face value of \$1,000, the owner can receive $\$1,000/\$359.87 = 2.7788$ shares of Tesla’s stock. The number of shares per bond, 2.7788 in this case, is called the **conversion ratio**.

When Tesla issued its convertible bonds, its common stock was trading at \$252.54 per share. The conversion price was $(\$359.87 - \$252.54)/\$252.54 = .425$, or 42.5 percent higher than its actual stock price. This 42.5 percent is called the **conversion premium**. It reflects the fact that the conversion option in Tesla’s bonds was out of the money at the time of issuance; this is usually the case.

Value of a Convertible Bond Even though the conversion feature of the convertible bond cannot be detached like a warrant, the value of the bond can still be decomposed into the bond value and the value of the conversion feature. We discuss how this is done next.

The easiest way to illustrate convertible bond valuation is with an example. Suppose a company called Micron Origami (MO) has an outstanding convertible bond issue. The coupon rate is 7 percent and the conversion ratio is 15. There are 12 remaining coupons, and the stock is trading for \$68.

Straight Bond Value The **straight bond value** is what the convertible bond would sell for if it could not be converted into common stock. This value will depend on the general level of interest rates on debentures and on the default risk of the issuer.

Suppose straight debentures issued by MO are rated B, and B-rated bonds are priced to yield 8 percent. We can determine the straight bond value of MO convertible bonds by discounting the \$35 semiannual coupon payments and maturity value at 8 percent, just as we did in Chapter 7:

$$\begin{aligned}\text{Straight bond value} &= \$35 \times (1 - 1/1.04^{12})/.04 + \$1,000/1.04^{12} \\ &= \$328.48 + 624.60 \\ &= \$953.07\end{aligned}$$

⁴Any dividends paid are, of course, not tax deductible for the corporation. Interest paid on a convertible bond is tax deductible.

The straight bond value of a convertible bond is a minimum value in the sense that the bond is always worth at least this amount. As we discuss next, it will usually be worth more.

Conversion Value The **conversion value** of a convertible bond is what the bond would be worth if it were immediately converted into common stock. We compare this value by multiplying the current price of the stock by the number of shares that will be received when the bond is converted.

Each MO convertible bond can be converted into 15 shares of MO common stock. MO common was selling for \$68. The conversion value was $15 \times \$68 = \$1,020$.

A convertible cannot sell for less than its conversion value, or an arbitrage opportunity exists. If MO's convertible had sold for less than \$1,020, investors would have bought the bonds, converted them into common stock, and sold the stock. The arbitrage profit would have been the difference between the value of the stock and the bond's conversion value.

Floor Value As we have seen, convertible bonds have two *floor values*: the straight bond value and the conversion value. The minimum value of a convertible bond is given by the greater of these two values. For the MO issue, the conversion value is \$1,020 and the straight bond value is \$953.07. At a minimum, this bond is worth \$1,020.

Figure 24.3 plots the minimum value of a convertible bond against the value of the stock. The conversion value is determined by the value of the firm's underlying common stock. As the value of the common stock rises and falls, the conversion value rises and falls with it. If the value of MO's common stock increases by \$1, the conversion value of its convertible bonds will increase by \$15.

In Figure 24.3, we have implicitly assumed that the convertible bond is default-free. In this case, the straight bond value does not depend on the stock price, so it is plotted as a horizontal line. Given the straight bond value, the minimum value of the convertible depends on the value of the stock. When the stock price is low, the minimum value of a convertible is most significantly influenced by the underlying value as straight debt. When

conversion value

The value a convertible bond would have if it were to be immediately converted into common stock.

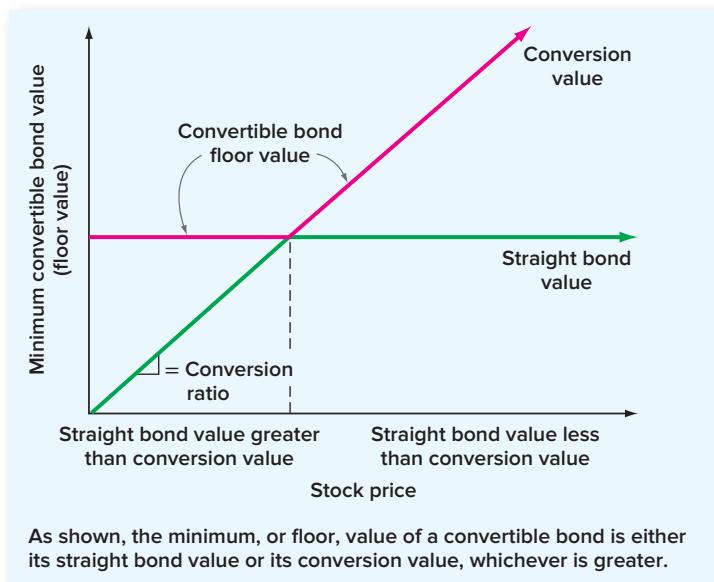
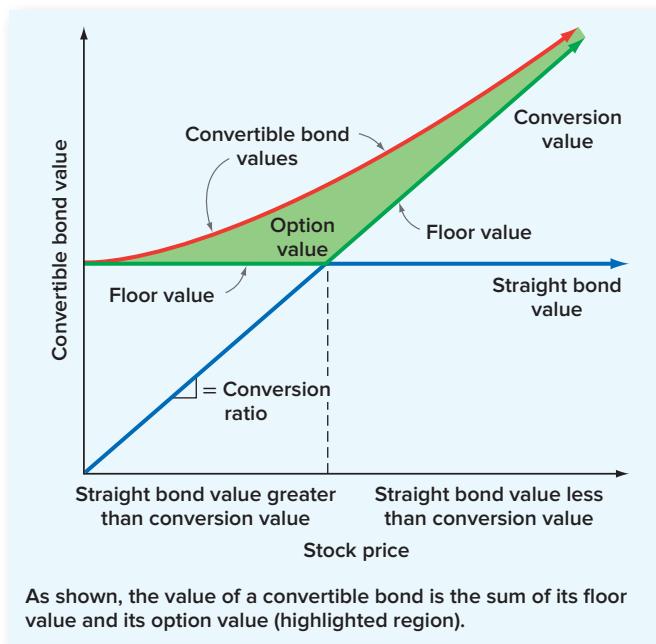


FIGURE 24.3

Minimum Value of a Convertible Bond versus the Value of the Stock for a Given Interest Rate

FIGURE 24.4

Value of a Convertible Bond versus the Value of the Stock for a Given Interest Rate



the value of the firm is very high, the value of a convertible bond is mostly determined by the underlying conversion value. This is also illustrated in Figure 24.3.

Option Value The value of a convertible bond will always exceed the straight bond value and the conversion value unless the firm is in default or the bondholders are forced to convert. The reason is that holders of convertibles do not have to convert immediately. Instead, by waiting, they can take advantage of whichever is greater in the future, the straight bond value or the conversion value.

This option to wait has value, and it raises the value of the convertible bond over its floor value. The total value of the convertible is equal to the sum of the floor value and the option value. This is illustrated in Figure 24.4. Notice the similarity between this picture and the representation of the value of a call option in Figure 24.2, referenced in our earlier discussion.

OTHER OPTIONS

We've discussed two of the more common optionlike securities: warrants and convertibles. Options appear in many other places. We briefly describe a few in this section.

The Call Provision on a Bond As we discussed in Chapter 7, most corporate bonds are callable. A call provision allows a corporation to buy the bonds at a fixed price for a fixed period of time. In other words, the corporation has a call option on the bonds. The cost of the call feature to the corporation is the cost of the option.

Convertible bonds are almost always callable. This means that a convertible bond is really a package of three securities: A straight bond, a call option held by the bondholder (the conversion feature), and a call option held by the corporation (the call provision).

Put Bonds As we discussed in Chapter 7, put bonds are a relatively new innovation. Recall that such a bond gives the owner the right to force the issuer to buy the bond back

at a fixed price for a fixed time. We now recognize that such a bond is a combination of a straight bond and a put option—hence the name.

A given bond can have a number of embedded options. One popular type of bond is a LYON, which stands for “liquid yield option note.” A LYON is a callable, putable, convertible, pure discount bond. It is a package of a pure discount bond, two call options, and a put option.

Insurance and Loan Guarantees Insurance of one kind or another is a financial feature of everyday life. Most of the time, having insurance is like having a put option. Suppose you have \$1 million in fire insurance on an office building. One night your building burns down, which reduces its value to nothing. In this case, you will effectively exercise your put option and force the insurer to pay you \$1 million for something worth very little.

Loan guarantees are a form of insurance. If you lend money to someone and they default, then, with a guaranteed loan, you can collect from someone else, often the government. When you lend money to a commercial bank (by making a deposit), your loan is guaranteed (up to \$250,000) by the government.

In two particularly well-known cases of loan guarantees, Lockheed (now Lockheed Martin) Corporation (in 1971) and Chrysler Corporation (in 1980) were saved from impending financial doom when the U.S. government came to the rescue by agreeing to guarantee new loans. Under the guarantees, if Lockheed or Chrysler had defaulted, the lenders could have obtained the full value of their claims from the U.S. government. From the lenders' point of view, the loans were as risk-free as Treasury bonds. These guarantees enabled Lockheed and Chrysler to borrow large amounts of cash and get through difficult times.

Loan guarantees are not cost-free. The U.S. government, with a loan guarantee, has provided a put option to the holders of risky bonds. The value of the put option is the cost of the loan guarantee. This point was made clear by the collapse of the U.S. savings and loan industry in the early 1980s. The final cost to U.S. taxpayers of making good on the guaranteed deposits in these institutions was a staggering \$150 billion.

In more recent times, following the September 11, 2001, terrorist attacks, Congress established the Air Transportation Stabilization Board (ATSB). The ATSB was authorized to issue up to \$10 billion in loan guarantees to U.S. air carriers that suffered losses as a result of the attacks. By mid-2004, \$1.56 billion in guarantees had been issued to six borrowers. Interestingly, recipients of loan guarantees were required to compensate the government for the risk being borne by the taxpayers. This compensation came in the form of cash fees and warrants to buy stock. These warrants represented between 10 and 33 percent of each company's equity. Because of recoveries (and subsequent stock price increases) at some borrowers, the ATSB's warrant portfolio became quite valuable. According to the U.S. Treasury Department, the government earned just under \$350 million from fees and stock sales.

Concept Questions

- 24.7a** How are warrants and call options different?
- 24.7b** What is the minimum value of a convertible bond?
- 24.7c** Explain how car insurance acts like a put option.
- 24.7d** Explain why U.S. government loan guarantees are not free.

24.8 Summary and Conclusions

This chapter has described the basics of option valuation and discussed optionlike corporate securities:

1. Options are contracts giving the right, but not the obligation, to buy and sell underlying assets at a fixed price during a specified period. The most familiar options are puts and calls involving shares of stock. These options give the holder the right, but not the obligation, to sell (the put option) or buy (the call option) shares of common stock at a given price.

As we discussed, the value of any option depends on only five factors:

- a. The price of the underlying asset.
 - b. The exercise price.
 - c. The expiration date.
 - d. The interest rate on risk-free bonds.
 - e. The volatility of the underlying asset's value.
2. Companies have begun to use employee stock options (ESOs) in rapidly growing numbers. Such options are similar to call options and serve to motivate employees to boost stock prices. ESOs are also an important form of compensation for many workers, particularly at more senior management levels.
 3. Almost all capital budgeting proposals can be viewed as real options. Also, projects and operations contain implicit options, such as the option to expand, the option to abandon, and the option to suspend or contract operations.
 4. A warrant gives the holder the right to buy shares of common stock directly from the company at a fixed exercise price for a given period of time. Typically, warrants are issued in a package with bonds. Afterwards, they often can be detached and traded separately.
 5. A convertible bond is a combination of a straight bond and a call option. The holder can give up the bond in exchange for a fixed number of shares of stock. The minimum value of a convertible bond is given by its straight bond value or its conversion value, whichever is greater.
 6. Many other corporate securities have option features. Bonds with call provisions, bonds with put provisions, and bonds backed by a loan guarantee are just a few examples.

CONNECT TO FINANCE



Do you use *Connect Finance* to practice what you have learned? If you don't, you should—we can help you master the topics presented in this material. Log on to connect.mheducation.com to learn more!

Can you answer the following *Connect Quiz* questions?

Section 24.1 Steve sold a put option when the option premium was \$1.20. What is Steve's total profit if the exercise price was \$15 and the option was never exercised?

Section 24.2 The value of a call option is equal to the _____.

Section 24.4 What is a “restruck” employee stock option?

CHAPTER REVIEW AND SELF-TEST PROBLEMS

- 24.1 Value of a Call Option** Stock in the Nantucket Corporation is currently selling for \$25 per share. In one year, the price will be either \$20 or \$30. T-bills with one year to maturity are paying 10 percent. What is the value of a call option with a \$20 exercise price? A \$26 exercise price?
- 24.2 Convertible Bonds** Old Cycle Corporation (OCC), publisher of *Ancient Iron* magazine, has a \$1,000 par value convertible bond issue that is currently selling in the market for \$950. Each bond can be exchanged for 100 shares of stock at the holder's option.

The bond has a 7 percent coupon, payable annually, and it will mature in 10 years. OCC's debt is BBB-rated. Debt with this rating is priced to yield 12 percent. Stock in OCC is trading at \$7 per share.

What is the conversion ratio on this bond? The conversion price? The conversion premium? What is the floor value of the bond? What is its option value?

ANSWERS TO CHAPTER REVIEW AND SELF-TEST PROBLEMS

- 24.1** With a \$20 exercise price, the option can't finish out of the money (it can finish "at the money" if the stock price is \$20). We can replicate the value of the stock by investing the present value of \$20 in T-bills and buying one call option. Buying the T-bill will cost $\$20/1.1 = \18.18 .

If the stock ends up at \$20, the call option will be worth zero and the T-bill will pay \$20. If the stock ends up at \$30, the T-bill will again pay \$20, and the option will be worth $\$30 - 20 = \10 , so the package will be worth \$30. Because the T-bill–call option combination exactly duplicates the payoff on the stock, it has to be worth \$25 or arbitrage is possible. Using the notation from the chapter, we can calculate the value of the call option:

$$\begin{aligned} S_0 &= C_0 + E/(1 + R_f) \\ \$25 &= C_0 + \$18.18 \\ C_0 &= \$6.82 \end{aligned}$$

With the \$26 exercise price, we start by investing the present value of the lower stock price in T-bills. This guarantees us \$20 when the stock price is \$20. If the stock price is \$30, then the option is worth $\$30 - 26 = \4 . We have \$20 from our T-bill, so we need \$10 from the options to match the stock. Because each option is worth \$4 in this case, we need to buy $\$10/\$4 = 2.5$ call options. Notice that the difference in the possible stock prices (ΔS) is \$10 and the difference in the possible option prices (ΔC) is \$4, so $\Delta S/\Delta C = 2.5$.

To complete the calculation, we note that the present value of the \$20 plus 2.5 call options has to be \$25 to prevent arbitrage, so:

$$\begin{aligned} \$25 &= 2.5 \times C_0 + \$20/1.1 \\ C_0 &= \$6.82/2.5 \\ &= \$2.73 \end{aligned}$$

- 24.2** Because each bond can be exchanged for 100 shares, the conversion ratio is 100. The conversion price is the face value of the bond (\$1,000) divided by the conversion ratio, or $\$1,000/100 = \10 . The conversion premium is the percentage difference between the current price and the conversion price, or $(\$10 - 7)/\$7 = .43$, or 43%.

The floor value of the bond is the greater of its straight bond value or its conversion value. Its conversion value is what the bond is worth if it is immediately converted: $100 \times \$7 = \700 . The straight bond value is what the bond would be worth if it were not convertible. The annual coupon is \$70, and the bond matures in 10 years. At a 12 percent required return, the straight bond value is:

$$\begin{aligned}\text{Straight bond value} &= \$70 \times (1 - 1/1.12^{10})/.12 + \$1,000/1.12^{10} \\ &= \$395.52 + 321.97 \\ &= \$717.49\end{aligned}$$

This exceeds the conversion value, so the floor value of the bond is \$717.49. Finally, the option value is the value of the convertible in excess of its floor value. Because the bond is selling for \$950, the option value is:

$$\begin{aligned}\text{Option value} &= \$950 - 717.49 \\ &= \$232.51\end{aligned}$$

CONCEPTS REVIEW AND CRITICAL THINKING QUESTIONS

- Options [LO1]** What is a call option? A put option? Under what circumstances might you want to buy each? Which one has greater *potential* profit? Why?
- Options [LO1]** Complete the following sentence for each of these investors:
 - A buyer of call options.
 - A buyer of put options.
 - A seller (writer) of call options.
 - A seller (writer) of put options.

“The (buyer/seller) of a (put/call) option (pays/receives) money for the (right/obligation) to (buy/sell) a specified asset at a fixed price for a fixed length of time.”
- Intrinsic Value [LO2]** What is the intrinsic value of a call option? How do we interpret this value?
- Put Options [LO2]** What is the value of a put option at maturity? Based on your answer, what is the intrinsic value of a put option?
- Option Pricing [LO2]** You notice that shares of stock in the Patel Corporation are going for \$50 per share. Call options with an exercise price of \$35 per share are selling for \$10. What’s wrong here? Describe how you can take advantage of this mispricing if the option expires today.
- Options and Stock Risk [LO2]** If the risk of a stock increases, what is likely to happen to the price of call options on the stock? To the price of put options? Why?
- Option Rise [LO2]** True or false: The unsystematic risk of a share of stock is irrelevant in valuing the stock because it can be diversified away; therefore, it is also irrelevant for valuing a call option on the stock. Explain.
- Option Pricing [LO2]** Suppose a certain stock currently sells for \$30 per share. If a put option and a call option are available with \$30 exercise prices, which do you think will sell for more, the put or the call? Explain.
- Option Price and Interest Rates [LO2]** Suppose the interest rate on T-bills suddenly and unexpectedly rises. All other things being the same, what is the impact on call option values? On put option values?

10. **Contingent Liabilities [LO4]** When you take out an ordinary student loan, it is usually the case that whoever holds that loan is given a guarantee by the U.S. government, meaning that the government will make up any payments you skip. This is one example of the many loan guarantees made by the U.S. government. Such guarantees don't show up in calculations of government spending or in official deficit figures. Why not? Should they show up?
11. **Option to Abandon [LO5]** What is the option to abandon? Explain why we underestimate NPV if we ignore this option.
12. **Option to Expand [LO5]** What is the option to expand? Explain why we underestimate NPV if we ignore this option.
13. **Capital Budgeting Options [LO5]** In Chapter 10, we discussed Porsche's launch of its new Cayenne. Suppose sales of the Cayenne go extremely well and Porsche is forced to expand output to meet demand. Porsche's action in this case would be an example of exploiting what kind of option?
14. **Option to Suspend [LO5]** Natural resource extraction facilities (such as oil wells or gold mines) provide a good example of the value of the option to suspend operations. Why?
15. **Employee Stock Options [LO3]** You own stock in the Hendrix Guitar Company. The company has implemented a plan to award employee stock options. As a shareholder, does the plan benefit you? If so, what are the benefits?

QUESTIONS AND PROBLEMS

1. **Calculating Option Values [LO2]** T-bills currently yield 3.4 percent. Stock in Deadwood Manufacturing is currently selling for \$58 per share. There is no possibility that the stock will be worth less than \$50 per share in one year.
 - a. What is the value of a call option with a \$45 exercise price? What is the intrinsic value?
 - b. What is the value of a call option with a \$35 exercise price? What is the intrinsic value?
 - c. What is the value of a put option with a \$45 exercise price? What is the intrinsic value?
2. **Understanding Option Quotes [LO1]** Use the option quote information shown here to answer the questions that follow. The stock is currently selling for \$85.



Option	Expiration	Strike Price	Calls		Puts	
			Vol.	Last	Vol.	Last
RWJ	Mar	80	230	2.80	160	.80
	Apr	80	170	6.00	127	1.40
	Jul	80	139	8.50	43	3.90
	Oct	80	60	10.20	11	3.65

- a. Are the call options in the money? What is the intrinsic value of an RWJ Corp. call option?
- b. Are the put options in the money? What is the intrinsic value of an RWJ Corp. put option?
- c. Two of the options are clearly mispriced. Which ones? At a minimum, what should the mispriced options sell for? Explain how you could profit from the mispricing in each case.

- 3. Calculating Payoffs [LO1]** Use the option quote information shown here to answer the questions that follow. The stock is currently selling for \$40.

Option	Expiration	Strike Price	Calls		Puts	
			Vol.	Last	Vol.	Last
Macrossoft	Feb	38	85	2.35	37	.24
	Mar	38	61	3.15	22	.93
	May	38	22	4.87	11	2.44
	Aug	38	3	6.15	3	3.56

- a. Suppose you buy 10 contracts of the February 38 call option. How much will you pay, ignoring commissions?
- b. In part (a), suppose that Macrossoft stock is selling for \$43 per share on the expiration date. How much is your options investment worth? What if the terminal stock price is \$39? Explain.
- c. Suppose you buy 10 contracts of the August 38 put option. What is your maximum gain? On the expiration date, Macrossoft is selling for \$32 per share. How much is your options investment worth? What is your net gain?
- d. In part (c), suppose you *sell* 10 of the August 38 put contracts. What is your net gain or loss if Macrossoft is selling for \$34 at expiration? For \$41? What is the break-even price—that is, the terminal stock price that results in a zero profit?
- 4. Calculating Option Values [LO2]** The price of Chive Corp. stock will be either \$67 or \$91 at the end of the year. Call options are available with one year to expiration. T-bills currently yield 4 percent.
 - a. Suppose the current price of the company's stock is \$75. What is the value of the call option if the exercise price is \$70 per share?
 - b. Suppose the exercise price is \$80 in part (a). What is the value of the call option now?
- 5. Calculating Option Values [LO2]** The price of Cilantro, Inc., stock will be either \$70 or \$90 at the end of the year. Call options are available with one year to expiration. T-bills currently yield 6 percent.
 - a. Suppose the current price of the company's stock is \$80. What is the value of the call option if the exercise price is \$60 per share?
 - b. Suppose the exercise price is \$65 in part (a). What is the value of the call option now?
- 6. Using the Pricing Equation [LO2]** A one-year call option contract on Cheesy Poofs Co. stock sells for \$845. In one year, the stock will be worth \$64 or \$81 per share. The exercise price on the call option is \$70. What is the current value of the stock if the risk-free rate is 3 percent?
- 7. Equity as an Option [LO4]** Rackin Pinion Corporation's assets are currently worth \$1,065. In one year, they will be worth either \$1,000 or \$1,340. The risk-free interest rate is 3.9 percent. Suppose the company has an outstanding debt issue with a face value of \$1,000.
 - a. What is the value of the equity?
 - b. What is the value of the debt? The interest rate on the debt?
 - c. Would the value of the equity go up or down if the risk-free rate were 20 percent? Why? What does your answer illustrate?

- 8. Equity as an Option [LO4]** Buckeye Industries has a bond issue with a face value of \$1,000 that is coming due in one year. The value of the company's assets is currently \$1,040. Urban Meyer, the CEO, believes that the assets in the company will be worth either \$940 or \$1,270 in a year. The going rate on one-year T-bills is 4.8 percent.
- What is the value of the company's equity? The value of the debt?
 - Suppose the company can reconfigure its existing assets in such a way that the value in a year will be \$850 or \$1,750. If the current value of the assets is unchanged, will the stockholders favor such a move? Why or why not?
- 9. Calculating Conversion Value [LO6]** A \$1,000 par convertible debenture has a conversion price for common stock of \$27 per share. With the common stock selling at \$31, what is the conversion value of the bond?
- 10. Convertible Bonds [LO6]** The following facts apply to a convertible bond making semiannual payments:

Conversion price	\$37/share
Coupon rate	2.6%
Par value	\$1,000
Yield on nonconvertible debentures of same quality	5%
Maturity	25 years
Market price of stock	\$34/share

- What is the minimum price at which the convertible should sell?
 - What accounts for the premium of the market price of a convertible bond over the total market value of the common stock into which it can be converted?
- 11. Calculating Values for Convertibles [LO6]** You have been hired to value a new 30-year callable, convertible bond. The bond has a coupon rate of 2.7 percent, payable semiannually, and its face value is \$1,000. The conversion price is \$54, and the stock currently sells for \$38.
- What is the minimum value of the bond? Comparable nonconvertible bonds are priced to yield 4.9 percent.
 - What is the conversion premium for this bond?
- 12. Calculating Warrant Values [LO6]** A bond with 20 detachable warrants has just been offered for sale at \$1,000. The bond matures in 20 years and has an annual coupon of \$24. Each warrant gives the owner the right to purchase two shares of stock in the company at \$45 per share. Ordinary bonds (with no warrants) of similar quality are priced to yield 6 percent. What is the value of one warrant?
- 13. Option to Wait [LO5]** Your company is deciding whether to invest in a new machine. The new machine will increase cash flow by \$275,000 per year. You believe the technology used in the machine has a 10-year life; in other words, no matter when you purchase the machine, it will be obsolete 10 years from today. The machine is currently priced at \$1.8 million. The cost of the machine will decline by \$140,000 per year until it reaches \$1.1 million, where it will remain. If your required return is 8 percent, should you purchase the machine? If so, when should you purchase it?
- 14. Abandonment Value [LO5]** We are examining a new project. We expect to sell 7,100 units per year at \$56 net cash flow apiece for the next 10 years. In other words,

 the annual cash flow is projected to be $\$56 \times 7,100 = \$397,600$. The relevant discount rate is 14 percent, and the initial investment required is \$1,800,000.

- a. What is the base-case NPV?
 - b. After the first year, the project can be dismantled and sold for \$1,200,000. If expected sales are revised based on the first year's performance, when would it make sense to abandon the investment? In other words, at what level of expected sales would it make sense to abandon the project?
 - c. Explain how the \$1,200,000 abandonment value can be viewed as the opportunity cost of keeping the project in one year.
15. **Abandonment [LO5]** In Problem 14, suppose you think it is likely that expected sales will be revised upward to 10,800 units if the first year is a success and revised downward to 3,900 units if the first year is not a success.
- a. If success and failure are equally likely, what is the NPV of the project? Consider the possibility of abandonment in answering.
 - b. What is the value of the option to abandon?
16. **Abandonment and Expansion [LO5]** In Problem 15, suppose the scale of the project can be doubled in one year in the sense that twice as many units can be produced and sold. Naturally, expansion would be desirable only if the project is a success. This implies that if the project is a success, projected sales after expansion will be 21,600. Again assuming that success and failure are equally likely, what is the NPV of the project? Note that abandonment is still an option if the project is a failure. What is the value of the option to expand?
17. **Intuition and Option Value [LO2]** Suppose a share of stock sells for \$63. The risk-free rate is 5 percent, and the stock price in one year will be either \$70 or \$80.
- a. What is the value of a call option with an exercise price of \$70?
 - b. What's wrong here? What would you do?
18. **Intuition and Convertibles [LO6]** Which of the following two sets of relationships, at time of issuance for convertible bonds, is more typical? Why?

	A	B
Offering price of bond	\$ 800	\$1,000
Bond value (straight debt)	800	950
Conversion value	1,000	900

19. **Convertible Calculations [LO6]** Campbell, Inc., has a \$1,000 face value convertible bond issue that is currently selling in the market for \$960. Each bond is exchangeable at any time for 18 shares of the company's stock. The convertible bond has a 4.9 percent coupon, payable semiannually. Similar nonconvertible bonds are priced to yield 7.4 percent. The bond matures in 20 years. Stock in the company sells for \$45 per share.
- a. What are the conversion ratio, conversion price, and conversion premium?
 - b. What is the straight bond value? The conversion value?
 - c. In part (b), what would the stock price have to be for the conversion value and the straight bond value to be equal?
 - d. What is the option value of the bond?
20. **Abandonment Decisions [LO5]** Liberty Products, Inc., is considering a new product launch. The firm expects to have annual operating cash flow of \$5.3 million for the next eight years. The company uses a discount rate of 11 percent for new product

launches. The initial investment is \$23 million. Assume that the project has no salvage value at the end of its economic life.

- a. What is the NPV of the new product?
- b. After the first year, the project can be dismantled and sold for \$18 million after taxes. If the estimates of remaining cash flows are revised based on the first year's experience, at what level of expected cash flows does it make sense to abandon the project?
21. **Pricing Convertibles [LO6]** You have been hired to value a new 25-year callable, convertible bond. The bond has a coupon rate of 2.3 percent, payable annually. The conversion price is \$68, and the stock currently sells for \$27.83. The stock price is expected to grow at 11 percent per year. The bond is callable at \$1,200, but, based on prior experience, it won't be called unless the conversion value is \$1,300. The required return on this bond is 8 percent. What value would you assign?
22. **Abandonment Decisions [LO5]** Consider the following project of Hand Clapper, Inc. The company is considering a four-year project to manufacture clap-command garage door openers. This project requires an initial investment of \$14 million that will be depreciated straight-line to zero over the project's life. An initial investment in net working capital of \$900,000 is required to support spare parts inventory; this cost is fully recoverable whenever the project ends. The company believes it can generate \$10.1 million in pretax revenues with \$3.8 million in total pretax operating costs. The tax rate is 38 percent and the discount rate is 13 percent. The market value of the equipment over the life of the project is as follows:

CHALLENGE
(Questions 21–22)



Year	Market Value (millions)
1	\$8.90
2	7.70
3	5.30
4	.00

- a. Assuming the company operates this project for four years, what is the NPV?
- b. Now compute the project NPV assuming the project is abandoned after only one year, after two years, and after three years. What economic life for this project maximizes its value to the firm? What does this problem tell you about not considering abandonment possibilities when evaluating projects?

MINICASE

S&S Air's Convertible Bond

S&S Air is preparing its first public securities offering. In consultation with Renata Harper of underwriter Raines and Warren, Chris Guthrie decided that a convertible bond with a 20-year maturity was the way to go. He met the owners, Mark and Todd, and presented his analysis of the convertible bond issue. Because the company is not publicly traded, Chris looked at comparable publicly traded companies and determined that the average PE ratio for the industry is 14.5. Earnings per share for the company are \$1.30. With this in mind, Chris has suggested a conversion price of \$25 per share.

Several days later, Todd, Mark, and Chris met again to discuss the potential bond issue. Both Todd and Mark had researched convertible bonds and they had some questions for Chris. Todd began by asking Chris if the convertible bond issue would have a lower coupon rate than a comparable bond without a conversion feature. Chris informed him that a par value convertible bond issue would require a 4 percent coupon rate with a conversion value of \$800, while a plain vanilla bond would have a 7 percent coupon rate. Todd nodded in agreement and explained that the convertible bonds are a win-win form of financing. He further explained that if the

value of the company stock did not rise above the conversion price, the company would be issuing debt at a cost below the market rate (4 percent instead of 7 percent). If the company's stock did rise to the conversion value, on the other hand, the company would be effectively issuing stock at a price above the current value.

Mark immediately disagreed, saying that convertible bonds are a no-win form of financing. He argued that if the value of the company stock were to rise to more than \$25, the company would be forced to sell stock at the conversion price. This means the new shareholders—in other words, those who bought the convertible bonds—would benefit from a bargain price. Put another way, if the company prospers, it would have been better to have issued straight debt so that the gains would not be shared.

Chris has gone back to Renata for help. As Renata's assistant, you've been asked to prepare another memo answering the following questions.

QUESTIONS

1. Why do you think Chris is suggesting a conversion price of \$25? Given that the company is not publicly traded, does it even make sense to talk about a conversion price?
2. Is there anything wrong with Todd's argument that it is cheaper to issue a bond with a convertible feature because the required coupon is lower?
3. Is there anything wrong with Mark's argument that a convertible bond is a bad idea because it allows new shareholders to participate in gains made by the company?
4. How can you reconcile the arguments made by Todd and Mark?
5. In the course of the debate, a question comes up concerning whether or not the bonds should have an ordinary (not make-whole) call feature. Chris confuses everybody by stating, "The call feature lets S&S Air force conversion, thereby minimizing the problem that Mark has identified." What is he talking about? Is he making sense?

Option Valuation

ON FEBRUARY 20, 2017, the closing stock prices for Walmart, rural retail store Tractor Supply Company, and medical technology company Inogen were \$71.74, \$71.32, and \$69.11, respectively. Each company had a call option trading on the Chicago Board Options Exchange with a \$70 strike price and an expiration date of April 21, 2017, 60 days away. You might expect that the prices on these call options would be similar, but they weren't. The Walmart options sold for \$1.39, Tractor Supply options traded at \$2.20, and Inogen options traded at \$5.00. Why would options on these three similarly priced stocks be priced so differently when the strike prices and the time to expiration were exactly the same? If you go back to our earlier chapter about options, the volatility of the underlying stock is an important determinant of an option's value, and, in fact, these three stocks have very different volatilities. In this chapter, we explore this issue—and many others—in much greater depth using the Nobel Prize-winning Black-Scholes option pricing model.

Learning Objectives

After studying this chapter, you should be able to:

- L01** Describe the relationship between stock prices, call prices, and put prices using put-call parity.
- L02** Describe the famous Black-Scholes option pricing model and its uses.
- L03** Explain how the five factors in the Black-Scholes formula affect the value of an option.
- L04** Demonstrate how the Black-Scholes model can be used to value the debt and equity of a firm.
- L05** Show how option valuation can result in some surprising conclusions regarding mergers and capital budgeting decisions.

©by Adri/StockPhotoGettyImages

For updates on the latest happenings in finance, visit fundamentals-of-corporate-finance.blogspot.com.

In an earlier chapter, we explored the basics of options, but we didn't discuss how to value them in much detail. Our goal in this chapter is to take this next step and examine how to actually estimate what an option is worth. To do this, we will explore two very famous results: The put-call parity condition and the Black-Scholes option pricing model.

An understanding of option valuation lets us illustrate and explore some very important ideas in corporate finance. We will show why certain types of mergers are a bad idea. We will also examine some conflicts between bondholder and stockholder interests. We will even provide some examples under which companies have an incentive to take negative NPV projects. In each case, option-related effects underlie the issue.

25.1 Put-Call Parity



From our earlier discussions, recall that the purchaser of a call option pays for the right, but not the obligation, to buy an asset for a fixed time at a fixed price. The purchaser of a put option pays for the right to sell an asset for a fixed time at a fixed price. The fixed price is called the *exercise* or *strike* price.

PROTECTIVE PUTS

Consider the following investment strategy. Today, you buy one share of Microsoft for \$110. At the same time, you also buy one put option with a \$105 strike price. The put option has a life of one year, and the premium is \$5. Your total investment is \$115, and your plan is to hold this investment for one year and then sell out.¹



The Options Industry Council has a web page featuring a lot of educational materials. See www.optionseducation.org.

protective put

The purchase of stock and a put option on the stock to limit the downside risk associated with the stock.

What have you accomplished here? To answer, we created Table 25.1, which shows your gains and losses one year from now for different stock prices. In the table, notice that the worst thing that ever happens to you is that the value of your investment falls to \$105. The reason is that if Microsoft's stock price is below \$105 per share one year from now, you will exercise your put option and sell your stock for the strike price of \$105; so that is the least you can possibly receive.

By purchasing the put option, you have limited your downside risk to a maximum potential loss of \$10 ($= \$115 - 105$). This particular strategy of buying a stock and also buying a put on the stock is called a **protective put** strategy because it protects you against losses beyond a certain point. Notice that the put option acts as a kind of insurance policy that pays off in the event that an asset you own (the stock) declines in value.

In our example, we picked a strike price of \$105. You could have picked a higher strike price and limited your downside risk to even less. Of course, a higher strike price would mean that you would have to pay more for the put option; so there is a trade-off between the amount of protection and the cost of that protection.

AN ALTERNATIVE STRATEGY

Now consider a different strategy. You take your \$115 and purchase a one-year *call* option on Microsoft with a strike price of \$105. The premium is \$15. That leaves you with

TABLE 25.1
Gains and Losses in One Year. Original investment: Purchase one share at \$110 plus a one-year put option with a strike price of \$105 for \$5. Total cost is \$115.

Stock Price in One Year	Value of Put Option (Strike Price = \$105)	Combined Value	Total Gain or Loss (Combined Value Less \$115)
\$125	\$ 0	\$125	\$ 10
120	0	120	5
115	0	115	0
110	0	110	-5
105	0	105	-10
100	5	105	-10
95	10	105	-10
90	15	105	-10

¹Of course, in reality, you can't buy an option on one share, so you would need to buy 100 shares of Microsoft and one put contract (at a minimum) to actually implement this strategy. We're explaining the calculations on a per-share basis.

Stock Price in One Year	Value of Call Option (Strike Price = \$105)	Value of Risk-Free Asset	Combined Value	Total Gain or Loss (Combined Value Less \$115)
\$125	\$ 20	\$105	\$125	\$ 10
120	15	105	120	5
115	10	105	115	0
110	5	105	110	-5
105	0	105	105	-10
100	0	105	105	-10
95	0	105	105	-10
90	0	105	105	-10

TABLE 25.2

Gains and Losses in One Year. Original investment: Purchase a one-year call option with a strike price of \$105 for \$15. Invest \$100 in a risk-free asset paying 5 percent. Total cost is \$115.

\$100, which you decide to invest in a riskless asset such as a T-bill. The risk-free rate is 5 percent.

What does this strategy accomplish? Once again, we will create a table to illustrate your gains and losses. Notice that in Table 25.2 your \$100 grows to \$105 based on a 5 percent interest rate. If you compare Table 25.2 to Table 25.1, you will make an interesting discovery. No matter what the stock price is one year from now, the two strategies *always* have the same value in one year!

The fact that the two strategies always have exactly the same value in one year explains why they have the same cost today. If one of these strategies were cheaper than the other today, there would be an arbitrage opportunity involving buying the one that's cheaper and simultaneously selling the one that's more expensive.

THE RESULT

Our example illustrates a very important pricing relationship. What it shows is that a protective put strategy can be exactly duplicated by a combination of a call option (with the same strike price as the put option) and a riskless investment. In our example, notice that the investment in the riskless asset, \$100, is exactly equal to the present value of the strike price on the option calculated at the risk-free rate: $\$105/1.05 = \100 .

Putting it all together, what we have discovered is the **put-call parity (PCP)** condition. It says that:

$$\text{Share of stock} + \text{put option} = \text{Present value of strike price} + \text{call option}$$

In symbols, we can write:

$$S + P = PV(E) + C$$

where S and P are stock and put values, respectively, and $PV(E)$ and C are the present value of the exercise price and the value of the call option, respectively.

Because the present value of the exercise price is calculated using the risk-free rate, you can think of it as the price of a risk-free, pure discount instrument (such as a T-bill) with a face value equal to the strike price. In our experience, the easiest way to remember the PCP condition is to remember that “stock plus put equals T-bill plus call.”

The PCP condition is an algebraic expression, meaning that it can be rearranged. Suppose we know that the risk-free rate is .5 percent per month. A call with a strike price of

put-call parity (PCP)

The relationship between the prices of the underlying stock, a call option, a put option, and a riskless asset.

25.1

25.2

\$40 sells for \$4, and a put with the same strike price sells for \$3. Both have a three-month maturity. What's the stock price?

To answer, we use the PCP condition to solve for the stock price:

$$\begin{aligned} S &= PV(E) + C - P \\ &= \$40/1.005^3 + \$4 - \$3 \\ &= \$40.41 \end{aligned}$$

25.3

The PCP condition really says that between a riskless asset (like a T-bill), a call option, a put option, and a share of stock, we can always figure out the price of any one of the four given the prices of the other three.

EXAMPLE 25.1

Put-Call Parity

Suppose a share of stock sells for \$60. A six-month call option with a \$70 strike price sells for \$2. The risk-free rate is .4 percent per month. What's the price of a six-month put option with a \$70 strike?

Using the PCP condition to solve for the put price, we get:

$$\begin{aligned} P &= PV(E) + C - S \\ &= \$70/1.004^6 + \$2 - \$60 \\ &= \$10.34 \end{aligned}$$

Notice that, in this example, the put option is worth a lot more than the call. Why?

EXAMPLE 25.2

More Parity

Suppose a share of stock sells for \$110. A one-year, at-the-money call option sells for \$15. An at-the-money put with the same maturity sells for \$5. Can you create a risk-free investment by combining these three instruments? How? What's the risk-free rate?

Here, we can use the PCP condition to solve for the present value of the strike price:

$$\begin{aligned} PV(E) &= S + P - C \\ &= \$110 + 5 - 15 \\ &= \$100 \end{aligned}$$

The present value of the strike price is \$100. Notice that because the options are at the money, the strike is the same as the stock price, \$110. So, if you put \$100 in a riskless investment today and receive \$110 in one year, the implied risk-free rate is obviously 10 percent.

CONTINUOUS COMPOUNDING: A REFRESHER COURSE

Back in Chapter 6, we saw that the effective annual interest rate (EAR) on an investment depends on compounding frequency. We also saw that, in the extreme, compounding can occur every instant, or continuously. So, as a quick refresher, suppose you invest \$100 at a rate of 6 percent per year compounded continuously. How much will you have in one year? How about in two years?

In Chapter 6, we saw that the EAR with continuous compounding is:

$$EAR = e^q - 1$$

where q is the quoted rate (6 percent, or .06, in this case) and e is the number 2.71828 ..., the base of the natural logarithms. Plugging in the numbers, we get:

$$\begin{aligned}\text{EAR} &= e^q - 1 \\ &= 2.71828^{.06} - 1 \\ &= .06184\end{aligned}$$

or about 6.2 percent. Notice that most calculators have a key labeled “ e^x ,” so doing this calculation is a matter of entering .06 and then pressing this key. With an EAR of 6.184 percent, your \$100 investment will grow to \$106.18 in one year. In two years, it will grow to:

$$\begin{aligned}\text{Future value} &= \$100 \times 1.06184^2 \\ &= \$100 \times 1.1275 \\ &= \$112.75\end{aligned}$$

When we move into option valuation, continuous compounding shows up quite a bit, and it helps to have some shortcuts. In our examples here, we first converted the continuously compounded rate to an EAR and then did our calculations. It turns out that we don’t need to do the conversion at all. Instead, we can calculate present and future values directly. In particular, the future value of \$1 for t periods at a continuously compounded rate of R per period is:

$$\text{Future value} = \$1 \times e^{Rt}$$

Looking back at the problem we just solved, the future value of \$100 in two years at a continuously compounded rate of 6 percent is:

$$\begin{aligned}\text{Future value} &= \$100 \times e^{.06(2)} \\ &= \$100 \times 2.71828^{.12} \\ &= \$100 \times 1.1275 \\ &= \$112.75\end{aligned}$$

which is exactly what we had before.

Similarly, we can calculate the present value of \$1 to be received in t periods at a continuously compounded rate of R per period as follows:

$$\text{Present value} = \$1 \times e^{-Rt}$$

So, if we want the present value of \$15,000 to be received in five years at 8 percent compounded continuously, we would calculate:

$$\begin{aligned}\text{Present value} &= \$15,000 \times e^{-.08(5)} \\ &= \$15,000 \times 2.71828^{-4} \\ &= \$15,000 \times .67032 \\ &= \$10,054.80\end{aligned}$$

Continuous Compounding

EXAMPLE 25.3

What is the present value of \$500 to be received in six months if the discount rate is 9 percent per year, compounded continuously?

In this case, notice that the number of periods is equal to one-half because six months is half of a year. The present value is:

$$\begin{aligned}\text{Present value} &= \$500 \times e^{-.09(1/2)} \\ &= \$500 \times 2.71828^{-0.45} \\ &= \$500 \times .956 \\ &= \$478\end{aligned}$$

Looking back at our PCP condition, we wrote:

$$S + P = PV(E) + C$$

If we assume that R is the continuously compounded risk-free rate per year, then we could write this as:

$$S + P = E \times e^{-Rt} + C$$

25.4

where t is the time to maturity (in years) on the options.

Finally, suppose we are given an EAR and we need to convert it to a continuously compounded rate. If the risk-free rate is 8 percent per year compounded annually, what's the continuously compounded risk-free rate?

Going back to our first formula, we had:

$$EAR = e^q - 1$$

Now, we need to solve for q , the continuously compounded rate. Plugging in the numbers, we have:

$$.08 = e^q - 1$$

$$e^q = 1.08$$

Taking the natural logarithm (\ln) of both sides to solve for q , we get:

$$\ln(e^q) = \ln(1.08)$$

$$q = .07696$$

or about 7.7 percent. Notice that most calculators have a button labeled “ \ln ”, so doing this calculation involves entering 1.08 and then pressing this key.

EXAMPLE 25.4

Even More Parity

Suppose a share of stock sells for \$30. A three-month call option with a \$25 strike sells for \$7. A three-month put with the same strike price sells for \$1. What's the continuously compounded risk-free rate?

We need to plug the relevant numbers into the PCP condition:

$$S + P = E \times e^{-Rt} + C$$

$$\$30 + 1 = \$25 \times e^{-R(1/4)} + \$7$$

Notice that we used one-fourth for the number of years because three months is a quarter of a year. We now need to solve for R :

$$\$24 = \$25 \times e^{-R(1/4)}$$

$$.96 = e^{-R(1/4)}$$

$$\ln(.96) = \ln(e^{-R(1/4)})$$

$$-.0408 = -R(1/4)$$

$$R = .1633, \text{ or } 16.33\%$$

This is about 16.33 percent, which is a very high risk-free rate!

Concept Questions

25.1a What is a protective put strategy?

25.1b What strategy exactly duplicates a protective put?

The Black-Scholes Option Pricing Model

25.2

We're now in a position to discuss one of the most celebrated results in modern finance, the Black-Scholes option pricing model (OPM). The OPM was an important discovery and the basis for the Nobel Prize in Economics in 1997. The underlying development of the Black-Scholes OPM is fairly complex, so we will focus only on the main result and how to use it.

Excel Master It!



Excel Master
coverage online

THE CALL OPTION PRICING FORMULA

Black and Scholes showed that the value of a European-style call option on a non-dividend-paying stock, C , can be written as follows:

$$C = S \times N(d_1) - E \times e^{-Rt} \times N(d_2)$$

25.5

where S , E , and e^{-Rt} are as we previously defined them and $N(d_1)$ and $N(d_2)$ are probabilities that must be calculated. More specifically, $N(d_1)$ is the probability that a standardized, normally distributed random variable (widely known as a "z" variable) is less than or equal to d_1 , and $N(d_2)$ is the probability of a value less than or equal to d_2 . Determining these probabilities requires a table such as Table 25.3.

To illustrate, suppose we are given the following information:

$$S = \$100$$

$$E = \$90$$

$$R = 4\% \text{ per year, continuously compounded}$$

$$d_1 = .60$$

$$d_2 = .30$$

$$t = 9 \text{ months}$$

Based on this information, what is the value of the call option, C ?

To answer, we need to determine $N(d_1)$ and $N(d_2)$. In Table 25.3, we first find the row corresponding to a d of $.60$. The corresponding probability $N(d)$ is $.7257$, so this is $N(d_1)$. For d_2 , the associated probability $N(d_2)$ is $.6179$. Using the Black-Scholes OPM, we calculate that the value of the call option is:

$$\begin{aligned} C &= S \times N(d_1) - E \times e^{-Rt} \times N(d_2) \\ &= \$100 \times .7257 - \$90 \times e^{-.04(3/4)} \times .6179 \\ &= \$18.60 \end{aligned}$$

Notice that t , the time to expiration, is 9 months, which is $9/12$, or $3/4$ of one year.

As this example illustrates, if we are given values for d_1 and d_2 (and the table), then using the Black-Scholes model is not difficult. Generally, we would not be given the values of d_1 and d_2 , and we would need to calculate them. This requires a little extra effort. The values for d_1 and d_2 for the Black-Scholes OPM are given by:

$$d_1 = [\ln(S/E) + (R + \sigma^2/2) \times t]/(\sigma \times \sqrt{t})$$

$$d_2 = d_1 - \sigma \times \sqrt{t}$$

25.6

In these expressions, σ is the standard deviation of the rate of return on the underlying asset. Also, $\ln(S/E)$ is the natural logarithm of the current stock price divided by the exercise price.

TABLE 25.3 Cumulative Normal Distribution

<i>d</i>	N(<i>d</i>)	<i>d</i>	N(<i>d</i>)	<i>d</i>	N(<i>d</i>)	<i>d</i>	N(<i>d</i>)	<i>d</i>	N(<i>d</i>)	<i>d</i>	N(<i>d</i>)
-3.00	.0013	-1.58	.0571	-.76	.2236	.06	.5239	.86	.8051	1.66	.9515
-2.95	.0016	-1.56	.0594	-.74	.2297	.08	.5319	.88	.8106	1.68	.9535
-2.90	.0019	-1.54	.0618	-.72	.2358	.10	.5398	.90	.8159	1.70	.9554
-2.85	.0022	-1.52	.0643	-.70	.2420	.12	.5478	.92	.8212	1.72	.9573
-2.80	.0026	-1.50	.0668	-.68	.2483	.14	.5557	.94	.8264	1.74	.9591
-2.75	.0030	-1.48	.0694	-.66	.2546	.16	.5636	.96	.8315	1.76	.9608
-2.70	.0035	-1.46	.0721	-.64	.2611	.18	.5714	.98	.8365	1.78	.9625
-2.65	.0040	-1.44	.0749	-.62	.2676	.20	.5793	1.00	.8413	1.80	.9641
-2.60	.0047	-1.42	.0778	-.60	.2743	.22	.5871	1.02	.8461	1.82	.9656
-2.55	.0054	-1.40	.0808	-.58	.2810	.24	.5948	1.04	.8508	1.84	.9671
-2.50	.0062	-1.38	.0838	-.56	.2877	.26	.6026	1.06	.8554	1.86	.9686
-2.45	.0071	-1.36	.0869	-.54	.2946	.28	.6103	1.08	.8599	1.88	.9699
-2.40	.0082	-1.34	.0901	-.52	.3015	.30	.6179	1.10	.8643	1.90	.9713
-2.35	.0094	-1.32	.0934	-.50	.3085	.32	.6255	1.12	.8686	1.92	.9726
-2.30	.0107	-1.30	.0968	-.48	.3156	.34	.6331	1.14	.8729	1.94	.9738
-2.25	.0122	-1.28	.1003	-.46	.3228	.36	.6406	1.16	.8770	1.96	.9750
-2.20	.0139	-1.26	.1038	-.44	.3300	.38	.6480	1.18	.8810	1.98	.9761
-2.15	.0158	-1.24	.1075	-.42	.3372	.40	.6554	1.20	.8849	2.00	.9772
-2.10	.0179	-1.22	.1112	-.40	.3446	.42	.6628	1.22	.8888	2.05	.9798
-2.05	.0202	-1.20	.1151	-.38	.3520	.44	.6700	1.24	.8925	2.10	.9821
-2.00	.0228	-1.18	.1190	-.36	.3594	.46	.6772	1.26	.8962	2.15	.9842
-1.98	.0239	-1.16	.1230	-.34	.3669	.48	.6844	1.28	.8997	2.20	.9861
-1.96	.0250	-1.14	.1271	-.32	.3745	.50	.6915	1.30	.9032	2.25	.9878
-1.94	.0262	-1.12	.1314	-.30	.3821	.52	.6985	1.32	.9066	2.30	.9893
-1.92	.0274	-1.10	.1357	-.28	.3897	.54	.7054	1.34	.9099	2.35	.9906
-1.90	.0287	-1.08	.1401	-.26	.3974	.56	.7123	1.36	.9131	2.40	.9918
-1.88	.0301	-1.06	.1446	-.24	.4052	.58	.7190	1.38	.9162	2.45	.9929
-1.86	.0314	-1.04	.1492	-.22	.4129	.60	.7257	1.40	.9192	2.50	.9938
-1.84	.0329	-1.02	.1539	-.20	.4207	.62	.7324	1.42	.9222	2.55	.9946
-1.82	.0344	-1.00	.1587	-.18	.4286	.64	.7389	1.44	.9251	2.60	.9953
-1.80	.0359	-.98	.1635	-.16	.4364	.66	.7454	1.46	.9279	2.65	.9960
-1.78	.0375	-.96	.1685	-.14	.4443	.68	.7518	1.48	.9306	2.70	.9965
-1.76	.0392	-.94	.1736	-.12	.4522	.70	.7580	1.50	.9332	2.75	.9970
-1.74	.0409	-.92	.1788	-.10	.4602	.72	.7642	1.52	.9357	2.80	.9974
-1.72	.0427	-.90	.1841	-.08	.4681	.74	.7704	1.54	.9382	2.85	.9978
-1.70	.0446	-.88	.1894	-.06	.4761	.76	.7764	1.56	.9406	2.90	.9981
-1.68	.0465	-.86	.1949	-.04	.4840	.78	.7823	1.58	.9429	2.95	.9984
-1.66	.0485	-.84	.2005	-.02	.4920	.80	.7881	1.60	.9452	3.00	.9987
-1.64	.0505	-.82	.2061	.00	.5000	.82	.7939	1.62	.9474	3.05	.9989
-1.62	.0526	-.80	.2119	.02	.5080	.84	.7995	1.64	.9495		
-1.60	.0548	-.78	.2177	.04	.5160						

This table shows the probability [N(*d*)] of observing a value less than or equal to *d*. For example, as illustrated, if *d* is $-.24$, then N(*d*) is .4052.

The formula for d_1 looks a little intimidating, but it is mostly a matter of plug and chug with a calculator. Suppose we have the following:

$$\begin{aligned}S &= \$70 \\E &= \$80 \\R &= 4\% \text{ per year, continuously compounded} \\\sigma &= 60\% \text{ per year} \\t &= 3 \text{ months}\end{aligned}$$

With these numbers, d_1 is:

$$\begin{aligned}d_1 &= [\ln(S/E) + (R + \sigma^2/2) \times t]/(\sigma \times \sqrt{t}) \\&= [\ln(\$70/\$80) + (.04 + .6^2/2) \times \frac{1}{4}] / (.6 \times \sqrt{\frac{1}{4}}) \\&= -.26 \\d_2 &= d_1 - \sigma \times \sqrt{t} \\&= -.26 - .6 \times \sqrt{\frac{1}{4}} \\&= -.56\end{aligned}$$

Referring to Table 25.3, the values of $N(d_1)$ and $N(d_2)$ are [.3974](#) and [.2877](#), respectively. Plugging all the numbers in, we get:

$$\begin{aligned}C &= S \times N(d_1) - E \times e^{-Rt} \times N(d_2) \\&= \$70 \times .3974 - \$80 \times e^{-.04(1/4)} \times .2877 \\&= \$5.03\end{aligned}$$

If you take a look at the Black-Scholes formula and our examples, you will see that the price of a call option depends on five, and only five, factors. These are the same factors that we identified earlier: Namely, the stock price, the strike price, the time to maturity, the risk-free rate, and the standard deviation of the return on the stock.

Call Option Pricing

EXAMPLE 25.5

Suppose you are given the following:

$$\begin{aligned}S &= \$40 \\E &= \$36 \\R &= 4\% \text{ per year, continuously compounded} \\\sigma &= 70\% \text{ per year} \\t &= 3 \text{ months}\end{aligned}$$

What's the value of a call option on the stock?

We need to use the Black-Scholes OPM. So, we first need to calculate d_1 and d_2 :

$$\begin{aligned}d_1 &= [\ln(S/E) + (R + \sigma^2/2) \times t]/(\sigma \times \sqrt{t}) \\&= [\ln(\$40/\$36) + (.04 + .7^2/2) \times \frac{1}{4}] / (.7 \times \sqrt{\frac{1}{4}}) \\&= .50 \\d_2 &= d_1 - \sigma \times \sqrt{t} \\&= .50 - .7 \times \sqrt{\frac{1}{4}} \\&= .15\end{aligned}$$

Referring to Table 25.3, the values of $N(d_1)$ and $N(d_2)$ are .6915 and .5597, respectively. To get the second of these, we averaged the two numbers on each side $(.5557 + .5636)/2 = .5597$. Plugging all the numbers in, we get the following:

$$\begin{aligned} C &= S \times N(d_1) - E \times e^{-Rt} \times N(d_2) \\ &= \$40 \times .6915 - \$36 \times e^{-0.04(1/4)} \times .5597 \\ &= \$7.71 \end{aligned}$$

A question that sometimes comes up concerns the probabilities $N(d_1)$ and $N(d_2)$. What are they the probabilities of? In other words, how do we interpret them? The answer is that they don't really correspond to anything in the real world. We mention this because there is a common misconception about $N(d_2)$ in particular. It is frequently thought to be the probability that the stock price will exceed the strike price on the expiration day, which is also the probability that a call option will finish in the money. Unfortunately, that's incorrect—at least not unless the expected return on the stock equals the risk-free rate.

Tables such as Table 25.3 are the traditional means of looking up z values, but they have been mostly replaced by computers. Tables are not as accurate because of rounding, and they also have only a limited number of values. Our nearby *Spreadsheet Strategies* box shows how to calculate Black-Scholes option prices using a spreadsheet. Because this is so much easier and more accurate, we will do all the calculations in the rest of this chapter using computers instead of tables.

SPREADSHEET STRATEGIES



	A	B	C	D	E	F	G	H	I	J	K
1											
2	Using a spreadsheet to calculate Black-Scholes option prices										
3											
4	XYZ stock has a price of \$65 and an annual return standard deviation of 50%. The riskless										
5	interest rate is 5%. Calculate call and put option prices with a strike of \$60 and a 3-month										
6	time to expiration.										
7											
8	Stock =	65	d1 =	.4952		N(d1) =	.6898				
9	Strike =	60									
10	Sigma =	.5	d2 =	.2452		N(d2) =	.5968				
11	Time =	.25									
12	Rate =	.05									
13											
14	Call = Stock x N(d1) – Strike x exp(- Rate x Time) x N(d2) =										\$9.47
15											
16	Put = Strike x exp(- Rate x Time) + Call – Stock =										\$3.72
17											
18	Formula entered in E8 is =(LN(B8/B9)+(B12+.5*B10^2)*B11)/(B10*SQRT(B11))										
19	Formula entered in E10 is =E8-B10*SQRT(B11)										
20	Formula entered in H8 is =NORMSDIST(E8)										
21	Formula entered in H10 is =NORMSDIST(E10)										
22	Formula entered in K14 is =B8*H8-B9*EXP(-B12*B11)*H10										
23	Formula entered in K16 is =B9*EXP(-B12*B11)+K14-B8										

PUT OPTION VALUATION

Our examples thus far have focused only on call options. A little extra work is needed to value put options. Basically, we pretend that a put option is a call option and use the

Black-Scholes formula to value it. We then use the put-call parity (PCP) condition to solve for the put value. To see how this works, suppose we have the following:

$$S = \$40$$

$$E = \$40$$

$$R = 4\% \text{ per year, continuously compounded}$$

$$\sigma = 80\% \text{ per year}$$

$$t = 4 \text{ months}$$

What's the value of a *put* option on the stock?

For practice, calculate the Black-Scholes call option price and see if you agree that a call option would be worth about \$7.53. Now, recall the PCP condition:

$$S + P = E \times e^{-Rt} + C$$

which we can rearrange to solve for the put price:

$$P = E \times e^{-Rt} + C - S$$

Plugging in the relevant numbers, we get:

$$\begin{aligned} P &= \$40 \times e^{-0.04(1/3)} + \$7.53 - \$40 \\ &= \$7.00 \end{aligned}$$

The value of a put option is \$7.00. So, once we know how to value call options, we also know how to value put options.

A CAUTIONARY NOTE

For practice, let's consider another put option value. Suppose we have the following:

$$S = \$70$$

$$E = \$90$$

$$R = 8\% \text{ per year, continuously compounded}$$

$$\sigma = 20\% \text{ per year}$$

$$t = 12 \text{ months}$$

What's the value of a put option on the stock?

For practice, calculate the call option's value and see if you get \$1.65. Once again, we use PCP to solve for the put price:

$$P = E \times e^{-Rt} + C - S$$

The put value we get is:

$$\begin{aligned} P &= \$90 \times e^{-0.08(1)} + \$1.65 - \$70 \\ &= \$14.73 \end{aligned}$$

Does something about our put option value seem odd? The answer is yes. Because the stock price is \$70 and the strike price is \$90, you could get \$20 by exercising the put immediately; so it looks like we have an arbitrage opportunity. Unfortunately, we don't. This example illustrates that we have to be careful with assumptions. The Black-Scholes formula is for *European*-style options (remember that European-style options can be exercised only on the final day, whereas American-style options can be exercised anytime). In fact, our PCP condition holds only for European-style options.

What our example shows is that an American-style put option is worth more than a European-style put. The reason is not hard to understand. Suppose you buy a put with a strike price of \$80. The very best thing that can happen is for the stock price to fall to zero.

If the stock price falls to zero, no further gain on your option is possible, so you will want to exercise it immediately rather than wait. If the option is American style, you can, but if it is European style, you cannot. More generally, it often pays to exercise a put option once it is well into the money because any additional potential gains are limited; exercising an American-style option is valuable.

What about call options? Here the answer is a little more encouraging. As long as we stick to non-dividend-paying stocks, it will never be optimal to exercise a call option early. Again, the reason is not complicated. A call option is worth more alive than dead, meaning you would always be better off selling the option than exercising it. In other words, for a call option, the exercise style is irrelevant.

Here is a challenge for the more mathematically inclined among you. We have a formula for a European-style put option. What about for an American-style put? Despite a great deal of effort, this problem has never been solved, so no formula is known. To be clear, we have numerical procedures for valuing put options, but no explicit formula. Call us if you figure one out.

Concept Questions

25.2a What are the five factors that determine an option's value?

25.2b Which is worth more, an American-style put or a European-style put? Why?

25.3 More about Black-Scholes



In this section, we take a closer look at the inputs into the option pricing formula and their effects on option values. Table 25.4 summarizes the inputs and their impacts (positive or negative) on option values. In the table, a plus sign means that increasing the input increases the option's value and vice versa.

Table 25.4 also indicates that four of the five effects have common names. For fairly obvious reasons given their names, these effects are collectively called the *greeks*. We discuss them in the next several sections. In some cases, the calculations can be fairly involved; but the good news is that options calculators are widely available on the web. See our nearby *Work the Web* box for one example.

VARYING THE STOCK PRICE

The effect that the stock price has on put and call values is pretty obvious. Increasing the stock price increases call values and decreases put values. However, the strength of

TABLE 25.4

Five Inputs Determining the Value of an American Option on a Non-Dividend-Paying Stock

Input	Impact on Option Price from an Increase in Input		Common Name
	Call Options	Put Options	
Stock price (S)	+	-	Delta
Strike price (E)	-	+	
Time to expiration (t)	+	+	Theta
Standard deviation of return on stock (σ)	+	+	Vega
Risk-free rate (R)	+	-	Rho

NOTE: The effect of increasing the time to maturity is positive for an American put option, but the impact is ambiguous for a European put.

WORK THE WEB

The Black-Scholes OPM is a wonderful tool; but as we have seen, the calculations can get somewhat tedious. One way to find the price of an option without the effort is to work the web. We went to the options calculator at www.ivolatility.com and entered “MSFT,” the ticker symbol for Microsoft. As shown, the current stock price is \$64.62, the standard deviation of the stock’s return is 17.88 percent per year, and the risk-free rate is .8019 percent. Here is what we found:



Symbol:	MSFT	Stock or Index Symbol	ALL	Go!
MSFT: NASDAQ - Microsoft Corp		Closing prices as of: 02/24/2017 Today's date: 02/27/2017		Calculators Help
Style:	American	Call	Put	
Price:	64.62	Symbol: MSFT 170407C00060000	Symbol: MSFT 170407P00060000	
Strike:	60	Option Value: 4.8433	0.1715	
Expiration Date:	Apr 07, 2017	Delta: 0.9055	-0.0943	
Days to Expiration:	39	Gamma: 0.0446	0.0447	
Volatility %:	17.88	Theta: -0.0093	-0.0080	
Interest Rate%:	0.8019	Vega: 0.0356	0.0369	
Dividends Date (mm/dd/yy):	02/14/17	Rho: 0.0573	-0.0063	
Dividends Amount:	0.39	Implied Volatility		
Dividends Frequency:	Quarterly	Option Price	Vola %	
	Call		0.00	
		Calculate		

As you can see, a call option on MSFT with a strike price of \$60 should sell for \$4.8433 and a put option should sell for \$.1715. Now that’s easy! Notice that the “greeks” are also calculated. What does “gamma” tell you? Visit the site to learn more.

Questions

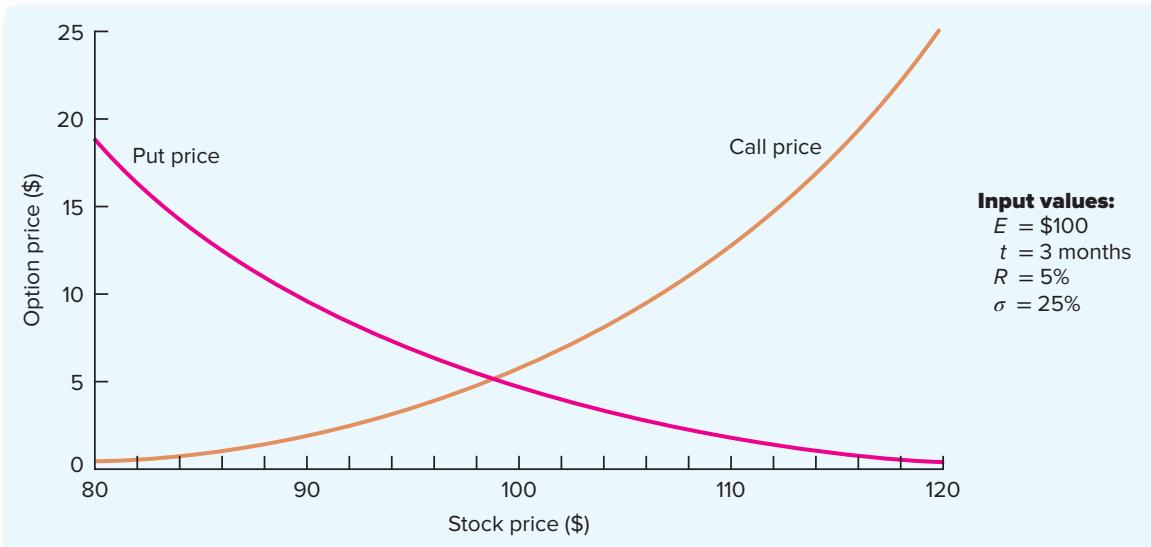
1. Go to www.ivolatility.com and find current option prices for Microsoft. Compare the prices of calls and puts with the same strike prices for the closest maturities and the most distant maturities. What relationship do you see in comparing these prices?
2. Go to www.ivolatility.com and find current option prices for eBay with strike prices closest to the current stock price. Compare the deltas of the calls and puts with the closest maturities and the most distant maturities. What relationship do you see in the deltas?

the effect varies depending on the “moneyness” of the option (how far in or out of the money it is).

For a given set of input values, we illustrate the relationship between call and put option prices and the underlying stock price in Figure 25.1. In the figure, stock prices are measured on the horizontal axis and option prices are measured on the vertical axis. Notice that the lines for put and call values are bowed. The reason is that the value of an option that is far out of the money is not as sensitive to a change in the underlying stock price as an in-the-money option.



Another good options calculator can be found at www.fintools.com/resources/online-calculators/options-calc/calculator/.

FIGURE 25.1 Put and Call Option Prices**delta**

Measures the effect on an option's value of a small change in the value of the underlying stock.

The sensitivity of an option's value to small changes in the price of the underlying stock is called the option's **delta**. For European options, we can directly measure the deltas as follows:

$$\text{Call option delta} = N(d_1)$$

$$\text{Put option delta} = N(d_1) - 1$$

The “ $N(d_1)$ ” that we need to calculate these deltas is the same one we used to calculate option values, so we already know how to do it. Remember that $N(d_1)$ is a probability, so its value ranges somewhere between 0 and 1.

For a small change in the stock price, the change in an option's price is approximately equal to its delta multiplied by the change in the stock price:

$$\text{Change in option value} \approx \text{Delta} \times \text{Change in stock value}$$

To illustrate this, suppose we are given the following:

$$S = \$120$$

$$E = \$100$$

$$R = 8\% \text{ per year, continuously compounded}$$

$$\sigma = 80\% \text{ per year}$$

$$t = 6 \text{ months}$$

Using the Black-Scholes formula, the value of a call option is \$37.80. The delta [$N(d_1)$] is .75, which tells us that if the stock price changes by, say, \$1, the option's value will change in the same direction by \$.75.

We can check this directly by changing the stock price to \$121 and recalculating the option value. If we do this, the new value of the call is \$38.55, an increase of \$.75; so the approximation is pretty accurate (it is off in the third decimal point).

If we price a put option using these same inputs, the value is \$13.88. The delta is .75 – 1, or –.25. If we increase the stock price to \$121, the new put value is \$13.63, a change of –.25; so, again, the approximation is fairly accurate as long as we stick to relatively small changes.

Looking back at our graph in Figure 25.1, we now see why the lines get progressively steeper as the stock price rises for calls and falls for puts. The delta for a deeply in-the-money option is close to 1, whereas the delta for a deeply out-of-the-money option is close to 0.

Delta

EXAMPLE 25.6

Suppose you are given the following:

$$S = \$40$$

$$E = \$30$$

$$R = 6\% \text{ per year, continuously compounded}$$

$$\sigma = 90\% \text{ per year}$$

$$t = 3 \text{ months}$$

What's the delta for a call option? A put option? Which one is more sensitive to a change in the stock price? Why?

We need to calculate $N(d_1)$. See if you agree that it's .815, which is the delta for the call. The delta for the put is $.815 - 1 = -.185$, which is much smaller (in absolute value). The reason is that the call option is well in the money and the put is out of the money.

VARYING THE TIME TO EXPIRATION

The impact of changing the time to maturity on American-style options is also fairly obvious. Because an American-style option can be exercised anytime, increasing the option's time to expiration can't possibly hurt and (especially for out-of-the-money options) might help. For both puts and calls, increasing the time to expiration has a positive effect.

For a European-style call option, increasing the time to expiration also never hurts because, as we discussed earlier, the option is always worth more alive than dead, and any extra time to expiration only adds to its "alive" value. With a European-style put, increasing the time to expiration may or may not increase the value of the option. As we have discussed, for a deep in-the-money put, immediate exercise is often desirable, so increasing the time to expiration only reduces the value of the option. If a put is out of the money, then increasing the time to expiration will probably increase its value.

Figure 25.2 shows the effect of increasing the time to expiration on a put and a call. The options are exactly at the money. In the figure, notice that once time to maturity reaches about six months, further increases have little impact on the put's value. The call's value, in contrast, keeps rising.

The sensitivity of an option's value to the passage of time is called its **theta**. There is a formula for theta, but it is fairly complicated, so we will not present it. The important thing to realize is that option values are sensitive to the passage of time (especially call option values). To see why this is important, imagine that you buy an option today and hold it for a month. During the month, the stock price never changes. What happens to the value of your option?

The value of your option declines because time to expiration has gotten shorter even though the underlying asset has not changed in value. We sometimes say that an option is a *wasting asset*, meaning that its value declines as time goes by, all else held constant. The tendency of an option's value to decline as time passes is also called *time decay*. An option's theta is a measure of the rate of time decay.

Recall from our earlier chapter about options that the intrinsic value of an option is:

$$\text{Call intrinsic value} = \text{Max}[S - E, 0]$$

$$\text{Put intrinsic value} = \text{Max}[E - S, 0]$$

theta

Measures the sensitivity of an option's value to a change in the time to expiration.

FIGURE 25.2 Option Prices and Time to Expiration

where “ $\text{Max}[S - E, 0]$ ” means $S - E$ or 0, whichever is higher. American-style options can never sell for less than their intrinsic value because, if one did, there would be an arbitrage opportunity. Suppose a stock sells for \$60. A three-month call option with a \$50 strike price sells for \$8. What do you think?

You think you are going to be rich because you can buy the option for \$8, exercise it for \$50, then sell the stock for \$60 for a \$2 riskless profit. To prevent this type of simple arbitrage, the option has to sell for at least its intrinsic value of $60 - 50 = \$10$. In reality, the option might sell for \$11. The extra \$1 in value over the intrinsic value is called the *time premium*. In other words, an option’s value can be written as:

$$\text{Option value} = \text{Intrinsic value} + \text{Time premium}$$

It is the time premium that wastes away or decays as time goes by. The reason is that the day an option expires, it is worth exactly its intrinsic value: On that day, it must be exercised or torn up. The existence of the time premium also explains our earlier observation that a call option is always worth more alive than dead. If you exercise an option, you receive the intrinsic value. If you sell it, you get the intrinsic value plus any remaining time premium.

EXAMPLE 25.7

Time Premiums

In February 2017, shares in Tesla Motors were going for about \$246.32. A call option expiring in November 2017 with a \$250 strike was quoted at \$27.28. A put with the same strike was quoted at \$35.98. For both options, what are the intrinsic value and time premium?

Beginning with the call option, we see that it is out of the money because the \$250 strike price is higher than the \$246.32 stock price. The intrinsic value is zero, and the entire \$27.28 is therefore time premium. The put is in the money, and its intrinsic value is $250 - 246.32 = \$3.68$. The put’s value is \$35.98, so the time premium is $35.98 - 3.68 = \$32.30$.

VARYING THE STANDARD DEVIATION

Figure 25.3 illustrates the impact on option values of varying the standard deviation of the return on the underlying asset. As shown, the effect is positive and pronounced for both puts and calls. In fact, increasing the standard deviation has an almost identical effect on them.

FIGURE 25.3 Option Prices and Sigma**FIGURE 25.4** Options Prices and Interest Rates

The sensitivity of an option's value to the volatility of the underlying asset is called its **vega**.² Once again, the formula is somewhat complicated, so we will omit it. The main thing to understand from Figure 25.3 is that option values are very sensitive to standard deviations, and changes in the volatility of the underlying asset's return can have a strong impact on option values.

vega

Measures the sensitivity of an option's value to a change in the standard deviation of the return on the underlying asset.

VARYING THE RISK-FREE RATE

We illustrate the effect of changing the risk-free rate on option values in Figure 25.4. As shown, increasing the risk-free rate has a positive impact on call values and a negative

²The Greek scholars among you will recognize that vega is not a Greek letter. (It is a star in the constellation Lyra and also a particularly forgettable automobile manufactured by Chevrolet in the 1960s and 1970s.)

rho

Measures the sensitivity of an option's value to a change in the risk-free rate.



For an option-oriented website focusing on volatilities, visit www.ivolatility.com.

implied standard deviation

An estimate of the future standard deviation of the return on an asset obtained from the Black-Scholes OPM.

impact on put values. Notice, for realistic changes in interest rates, option values don't change a lot. In other words, option values are not as sensitive to changes in interest rates as they are to, say, changes in volatilities. An option's sensitivity to interest rate changes is called its **rho**.

There are a few other greeks in addition to the ones we have discussed, but we will end our Greek lesson here. What we now discuss is a very important use of Black-Scholes: The calculation of implied volatilities.

IMPLIED STANDARD DEVIATIONS

Thus far, we have focused on using the Black-Scholes OPM to calculate option values; but there is another very important use. Of the five factors that determine an option's value, four can be directly observed: The stock price, the strike price, the risk-free rate, and the life of the option. Only the standard deviation must be estimated.

The standard deviation we use in the OPM is actually a prediction of what the standard deviation of the underlying asset's return is going to be over the life of the option. Often, we already know the value of an option because we observe its price in the financial markets. In such cases, we can use the value of the option, along with the four observable inputs, to back out a value for the standard deviation. When we solve for the standard deviation this way, the result is called the **implied standard deviation** or ISD (which some people pronounce as "iz-dee"), also known as the *implied volatility*.

To illustrate this calculation, suppose we are given the following:

$$S = \$12$$

$$E = \$8$$

$R = 5\%$ per year, continuously compounded

$$t = 6 \text{ months}$$

We also know that the call option sells for \$4.59. Based on this information, how volatile is the stock expected to be over the next three months?

If we plug all this information into the Black-Scholes formula, we are left with one unknown: The standard deviation (σ). However, it's not possible to directly solve for σ , so trial and error must be used. In other words, we start plugging in values for σ until we find one that produces the call price of \$4.59.

For a stock option, .50 is a good place to start. If you plug this in, you will see that the calculated call value is \$4.38, which is too low. Recall that option values increase as we increase σ , so we might try .60. Now the option value is \$4.53, so we're getting close, but we're still low. At .65, the calculated value is \$4.61, which is just a little too high. After a little more work, we discover that the implied volatility is .64, or 64 percent.

If you want to find the ISD for the overall stock market, you can do so easily. The VIX is the implied volatility of S&P 500 options for the next 30 days. It is often viewed as a fear gauge because a higher VIX implies that the market expects a higher volatility in the next 30 days. Historically, the VIX has been 15 to 20, although it climbed into the 80s during the market turmoil of 2008. In order to allow investors to trade on volatility, exchange-traded futures and options are available on the VIX index. Here is a question for you: Suppose you were to calculate the ISD of a VIX option. What would this number mean?

EXAMPLE 25.8**ISD**

On February 28, 2017, common stock in social network company Facebook closed at \$135.45. A call option expiring on September 15, 2017, with a strike price of \$140 traded for \$8.25. Treasury bills maturing on September 15, 2017, were paying 1.077 percent. Based on this information, how volatile is the return on Facebook predicted to be?

To summarize, the relevant numbers we have are:

$$S = \$135.45$$

$$E = \$140$$

$R = 1.077\%$ per year, compounded annually

$$\sigma = ?$$

$$t = 199 \text{ days}$$

$$C = \$8.25$$

From here, it's plug and chug. As you have probably figured out by now, it's easier to use an options calculator to solve this problem. That's what we did; the implied standard deviation is about 25 percent. Our nearby *Work the Web* box shows you how to do this.

In principle, to solve this problem, we need to convert the interest rate of 1.077 percent to a continuously compounded rate. If we do this, we get 1.0828 percent. However, we've seen that option values are not very sensitive to small changes in interest rates; and in this case, it actually makes almost no difference. For this reason, in practice, the continuous compounding issue is often ignored, especially when rates are low.

WORK THE WEB

From our discussion of implied standard deviation, you can see that solving for ISD when you know the option price is done by trial and error. Fortunately, most options calculators will do the work for you. To illustrate, we found the ISD for the Facebook call option we discussed in Example 25.8. To refresh your memory, Facebook stock closed at \$135.45. A call option with a strike price of \$140 and a maturity of 199 days was selling for \$8.25. Treasury bills with the same maturity had a yield of 1.0828 percent. What is the ISD of Facebook stock? We went to www.vindeep.com and used the options calculator at the site. After entering all the information, this is what we found:



Option Type	Call Option
Spot Price	135.45
Strike Price	140
Risk Free Rate	1.0828 %
Time To Expiry	199 Days
Market Price	8.25
Implied Volatility	24.77 %

So, Facebook stock has an ISD of 24.77 percent per year.

Questions

1. Go to finance.yahoo.com and find option quotes for IBM. Pick a maturity and find the lowest strike price call, the call with a strike price nearest the current stock price, and the call with the highest strike price. Calculate the implied standard deviation for each using the calculator at www.vindeep.com. What do you observe?
2. Go to finance.yahoo.com and find option quotes for Pfizer. Pick three call options with a strike price near the current stock price with different expiration months. Calculate the implied standard deviations using the calculator at www.vindeep.com. What do you observe?

Concept Questions

25.3a What are an option's delta, rho, theta, and vega?

25.3b What is an ISD?

25.4 Valuation of Equity and Debt in a Leveraged Firm

In our earlier chapter about options, we pointed out that the equity in a leveraged corporation (a corporation that has borrowed money) can be viewed as a call option on the assets of the business. The reason is that when a debt comes due, the stockholders have the option to pay off the debt, and thereby acquire the assets free and clear, or else default. The act of paying off the debt amounts to exercising an in-the-money call option to acquire the assets. Defaulting amounts to letting an out-of-the-money call option expire. In this section, we expand on the idea of equity as a call option in several ways.

VALUING THE EQUITY IN A LEVERAGED FIRM

Consider a firm that has a single zero coupon bond issue outstanding with a face value of \$10 million. It matures in six years. The firm's assets have a current *market* value of \$12 million. The volatility (standard deviation) of the return on the firm's assets is 40 percent per year. The continuously compounded risk-free rate is 6 percent. What is the current market value of the firm's equity? Its debt? What is its continuously compounded cost of debt?

What this case amounts to is that the stockholders have the right, but not the obligation, to pay \$10 million in six years. If they do, they get the assets of the firm. If they don't, they default and get nothing. So, the equity in the firm is a call option with a strike price of \$10 million.

Using the Black-Scholes formula in this case can be a little confusing because now we are solving for the stock price. The symbol "C" is the value of the stock, and the symbol "S" is the value of the firm's assets. With this in mind, we can value the equity of the firm by plugging the numbers into the Black-Scholes OPM with $S = \$12$ million and $E = \$10$ million. When we do so, we get \$6.554 million as the value of the equity, with a delta of .852.

Now that we know the value of the equity, we can calculate the value of the debt using the standard balance sheet identity. The firm's assets are worth \$12 million and the equity is worth \$6.554 million, so the debt is worth $\$12 - \$6.554 = \$5.446$ million.

To calculate the firm's continuously compounded cost of debt, we observe that the present value is \$5.446 million and the future value in six years is the \$10 million face value. We need to solve for a continuously compounded rate, R_D , as follows:

$$\begin{aligned} \$5.446 &= \$10 \times e^{-R_D(6)} \\ .5446 &= e^{-R_D(6)} \\ R_D &= -1/6 \times \ln(.5446) \\ &= .10 \end{aligned}$$

So, the firm's cost of debt is 10 percent, compared to a risk-free rate of 6 percent. The extra 4 percent is the default risk premium—that is, the extra compensation the bondholders demand because of the risk that the firm will default and bondholders will receive assets worth less than \$10 million.

We also know that the delta of the option here is .852. How do we interpret this? In the context of valuing equity as a call option, the delta tells us what happens to the value of the equity when the value of the firm's assets changes. This is an important consideration. Suppose the firm undertakes a project with an NPV of \$100,000, meaning that the value of the firm's assets will rise by \$100,000. We now see that the value of the stock will rise (approximately) by only $.852 \times \$100,000 = \$85,162$.³ Why?

The reason is that the firm has made its assets more valuable, which means default is less likely to occur in the future. As a result, the bonds gain value, too. How much do they gain? The answer is $\$100,000 - 85,162 = \$14,838$ —in other words, whatever value the stockholders don't get.

Equity as a Call Option

EXAMPLE 25.9

Consider a firm that has a single zero coupon bond issue outstanding with a face value of \$40 million. It matures in five years. The risk-free rate is 4 percent. The firm's assets have a current market value of \$35 million, and the firm's equity is worth \$15 million. If the firm takes a project with a \$200,000 NPV, approximately how much will the stockholders gain?

To answer this question, we need to know the delta, so we need to calculate $N(d_1)$. To do this, we need to know the relevant standard deviation, which we don't have. We do have the value of the option (\$15 million), though, so we can calculate the ISD. If we use $C = \$15$ million, $S = \$35$ million, and $E = \$40$ million along with the risk-free rate of 4 percent and time to expiration of five years, we find that the ISD is 48.1 percent. With this value, the delta is .725; so, if \$200,000 in value is created, the stockholders will get 72.5 percent of it, or about \$145,000.

OPTIONS AND THE VALUATION OF RISKY BONDS

Let's continue with the case we just examined of a firm with \$12 million in assets and a six-year, zero coupon bond with a face value of \$10 million. Given the other numbers, we showed that the bonds were worth \$5.446 million. Suppose that the holders of these bonds wish to eliminate the risk of default. In other words, the holders want to turn their risky bonds into risk-free bonds. How can they do this?

The answer is that the bondholders can do a protective put along the lines we described earlier in the chapter. In this case, the bondholders want to make sure their bonds will never

³Delta is used to evaluate the effect of a small change in the underlying asset's value, so it might look like we shouldn't use it to evaluate a shift of \$100,000. "Small" is relative, however, and \$100,000 is small relative to the \$12 million total asset value.

be worth less than the face value of \$10 million, so the bondholders need to purchase a put option with a six-year life and a \$10 million face value. The put option is an option to sell the assets of the firm for \$10 million.

Remember that if the assets of the firm are worth more than \$10 million in six years, the shareholders will pay the \$10 million. If the assets are worth less than \$10 million, the stockholders will default, and the bondholders will receive the assets of the firm. At that point, however, the bondholders will exercise their put and sell the assets for \$10 million. Either way, the bondholders get \$10 million.

What we have discovered is that a risk-free bond is the same thing as a combination of a risky bond and a put option on the assets of the firm with a matching maturity and a strike price equal to the face value of the bond:

$$\text{Value of risky bond} + \text{Put option} = \text{Value of risk-free bond}$$

25.7

In our example, the face value of the debt is \$10 million, and the risk-free rate is 6 percent, so the value of the bonds if they were risk-free would be:

$$\begin{aligned}\text{Value of risk-free bonds} &= \$10 \text{ million} \times e^{-0.06(6)} \\ &= \$6.977 \text{ million}\end{aligned}$$

If we compare this to the value of the risky bonds, \$5.446 million, we see that the put option is worth $\$6.977 - \$5.446 = \$1.531$ million. Notice that the value of the risk-free bonds is also the present value of the strike price at the risk-free rate.

We can check that this put value is correct. We know the value of the underlying assets is \$12 million, the value of the call option (the stock) is \$6.554 million, and the present value of the strike price is \$6.977 million. Using the PCP condition:

$$\begin{aligned}P &= \$6.977 + \$6.554 - \$12 \\ &= \$1.531 \text{ million}\end{aligned}$$

which is exactly what we calculated.

We can restate our result here as follows:

$$\begin{aligned}\text{Value of risky bond} &= \text{Value of risk-free bond} - \text{Put option} \\ &= E \times e^{-Rt} - P\end{aligned}$$

25.8

This shows us that anything that increases the value of the put option *decreases* the value of the firm's bonds. With this in mind, we can use the PCP condition to bring together and unite a lot of our discussion in this chapter (and this book!).

Using the PCP condition, we can write:

$$S = C + E \times e^{-Rt} - P$$

Remember that, in this case, the stock is the underlying asset. Now, if we are thinking of the stock in a firm as being a call option on the assets of the firm, here is how we would interpret this:

$$\text{Value of assets (S)} = \text{Value of stock (C)} + (E \times e^{-Rt} - P)$$

25.9

where E , the strike price, is the face value of the firm's debt. Notice that, as we have just seen, the term in parentheses is the value of the firm's risky bonds, so this expression is really the balance sheet identity:

$$\text{Value of assets (S)} = \text{Value of stock (C)} + \text{Value of bonds (E} \times e^{-Rt} - P\text{)}$$

25.10

The PCP condition and the balance sheet identity say the same thing, but recognizing the nature of the optionlike features of the equity and debt in a leveraged firm leads to a far richer understanding of corporate finance. We illustrate some important examples in the next section.

Concept Questions

- 25.4a** Why do we say that the equity in a leveraged firm is a call option? What does the delta of the call option tell us in this context?
- 25.4b** What is the connection between the standard balance sheet identity and the put-call parity (PCP) condition?

Options and Corporate Decisions: Some Applications

25.5

In this section, we explore the implications of options analysis in two key areas: Capital budgeting and mergers. We start with mergers and show a very surprising result. We then go on to show that the net present value rule has some important wrinkles in a leveraged firm.

MERGERS AND DIVERSIFICATION

Elsewhere in our book, we discuss mergers and acquisitions. There we mention that diversification is frequently cited as a reason for two firms to merge. Is diversification a good reason to merge? It might seem so. After all, in an earlier chapter, we spent a lot of time explaining why diversification is very valuable for investors in their own portfolios because of the elimination of unsystematic risk.

To investigate this issue, let's consider two companies, Sunshine Swimwear (SS) and Polar Winterwear (PW). For obvious reasons, both companies have seasonal cash flows; in their respective off-seasons, both companies worry about cash flow. If the two companies were to merge, the combined company would have a much more stable cash flow. In other words, a merger would diversify away some of the seasonal variation and, in fact, would make bankruptcy much less likely.

Notice that the operations of the two firms are very different, so the proposed merger is a purely “financial” merger. This means there are no “synergies” or other value-creating possibilities except possible gains from risk reduction. Here is some premerger information:

	Sunshine Swimwear	Polar Winterwear
Market value of assets	\$30 million	\$10 million
Face value of pure discount debt	\$12 million	\$ 4 million
Debt maturity	3 years	3 years
Asset return standard deviation	50 percent	60 percent

The risk-free rate, continuously compounded, is 5 percent. Given this, we can calculate the following (check these for practice):

	Sunshine Swimwear	Polar Winterwear
Market value of equity	\$20.424 million	\$7.001 million
Market value of debt	\$9.576 million	\$2.999 million

If you check these, you may get slightly different answers if you use Table 25.3 (we used an options calculator).

After the merger, the combined firm's assets will be the sum of the premerger values, $\$30 + 10 = \40 , because no value was created or destroyed. Similarly, the total face value of the debt is now \$16 million. However, we will assume that the combined firm's asset return standard deviation is 40 percent. This is lower than for either of the two individual firms because of the diversification effect.

So, what is the impact of this merger? To find out, we compute the postmerger value of the equity. Based on our discussion, here is the relevant information:

Combined Firm	
Market value of assets	\$40 million
Face value of pure discount debt	\$16 million
Debt maturity	3 years
Asset return standard deviation	40 percent

Once again, we can calculate equity and debt values:

Combined Firm	
Market value of equity	\$26.646 million
Market value of debt	\$13.354 million

What we notice is that this merger is a terrible idea, at least for the stockholders! Before the merger, the stock in the two separate firms was worth a total of $\$20.424 + 7.001 = \27.425 million, compared to only \$26.646 million postmerger, so the merger vaporized $\$27.425 - \$26.646 = \$.779$ million, or almost \$1 million, in equity.

Where did nearly \$1 million in equity go? It went to the bondholders. Their bonds were worth $\$9.576 + 2.999 = \12.575 million before the merger and \$13.354 million after, a gain of exactly \$.779 million. This merger neither created nor destroyed value, but it shifted it from the stockholders to the bondholders.

Our example shows that pure financial mergers are a bad idea, and it also shows why. The diversification works in the sense that it reduces the volatility of the firm's return on assets. This risk reduction benefits the bondholders by making default less likely. This is sometimes called the *coinsurance effect*. Essentially, by merging, the firms insure each other's bonds. The bonds are less risky, and they rise in value. If the bonds increase in value, and there is no net increase in asset values, then the equity must decrease in value. So, pure financial mergers are good for creditors, but not stockholders.

Another way to see this is that because the equity is a call option, a reduction in return variance on the underlying asset has to reduce its value. The reduction in value in the case of a purely financial merger has an interesting interpretation. The merger makes default (and bankruptcy) *less* likely to happen. That is obviously a good thing from a bondholder's perspective, but why is it a bad thing from a stockholder's perspective? The answer is simple: The right to go bankrupt is a valuable stockholder option. A purely financial merger reduces the value of that option.

OPTIONS AND CAPITAL BUDGETING

In our earlier chapter about options, we discussed the many options embedded in capital budgeting decisions, including the option to wait, the option to abandon, and others. To add to these option-related issues, we now consider two additional issues. What we show is that, for a leveraged firm, the shareholders might prefer a lower NPV project to a higher one. We then show that they might even prefer a *negative* NPV project to a positive NPV project.

As usual, we will illustrate these points first with an example. Here is the basic background information for the firm:

Market value of assets	\$20 million
Face value of pure discount debt	\$40 million
Debt maturity	5 years
Asset return standard deviation	50 percent

The risk-free rate is 4 percent. As we have now done many times, we can calculate equity and debt values:

Market value of equity	\$5.744
Market value of debt	\$14.256

This firm has a fairly high degree of leverage; the debt-equity ratio based on market values is $\$14.256/\$5.744 = 2.48$, or 248 percent. This is high, but not unheard of. Notice also that the option here is out of the money; as a result, the delta is .547.

The firm has two mutually exclusive investments under consideration. They both must be taken now or never, so there is no timing issue. The projects affect both the market value of the firm's assets and the firm's asset return standard deviation as follows:

	Project A	Project B
NPV (millions)	\$4	\$2
Market value of firm's assets ($\$20 + \text{NPV}$)	\$24	\$22
Firm's asset return standard deviation	40 percent	60 percent

Which project is better? It is obvious that Project A has the higher NPV, but by now you are wary of the change in the firm's asset return standard deviation. One project reduces it; the other increases it. To see which project the stockholders like better, we have to go through our (by now) very familiar calculations:

	Project A	Project B
Market value of equity	\$5.965	\$8.751
Market value of debt	\$18.035	\$13.249

There is a dramatic difference between the two projects. Project A benefits both the stockholders and the bondholders, but most of the gain goes to the bondholders. Project B has a huge impact on the value of the equity, plus it reduces the value of the debt. Clearly, the stockholders prefer B.

What are the implications of our analysis? We have discovered two things. First, when the equity has a delta significantly smaller than 1.0, any value created will go partially to bondholders. Second, stockholders have a strong incentive to increase the variance of the return on the firm's assets. More specifically, stockholders will have a strong preference for variance-increasing projects as opposed to variance-decreasing ones, even if that means a lower NPV.

Let's do one final example. Here is a different set of numbers:

Market value of assets	\$20 million
Face value of pure discount debt	\$100 million
Debt maturity	5 years
Asset return standard deviation	50 percent

The risk-free rate is 4 percent, so the equity and debt values are:

Market value of equity	\$2.012 million
Market value of debt	\$17.988 million

Notice that the change from our previous example is that the face value of the debt is now \$100 million, so the option is far out of the money. The delta is only .241, so most of any value created will go to the bondholders.

The firm has an investment under consideration that must be taken now or never. The project affects both the market value of the firm's assets and the firm's asset return standard deviation as follows:

Project NPV	-\$1 million
Market value of firm's assets (\$20 million + NPV)	\$19 million
Firm's asset return standard deviation	70 percent

The project has a negative NPV, but it increases the standard deviation of the firm's return on assets. If the firm takes the project, here is the result:

Market value of equity	\$4.834 million
Market value of debt	\$14.166 million

This project more than doubles the value of the equity! Once again, what we are seeing is that stockholders have a strong incentive to increase volatility, particularly when the option is far out of the money. What is happening is that the shareholders have relatively little to lose because bankruptcy is the likely outcome. As a result, there is a strong incentive to go for a long shot, even if that long shot has a negative NPV. It's a bit like using your very last dollar on a lottery ticket. It's a bad investment, but there aren't a lot of other options!

Concept Questions

- 25.5a** What is a pure financial merger?
25.5b Why might stockholders in a leveraged firm prefer a low NPV project over a higher NPV project?

25.6 Summary and Conclusions

This chapter introduced the wide world of option valuation and some of its more important implications for corporate finance:

1. The put-call parity (PCP) condition tells us that among a call option, a put option, a risk-free investment like a T-bill, and an underlying asset such as shares of stock, we can replicate any one using the other three.
2. The Black-Scholes option pricing model (OPM) lets us explicitly value call options given values for the five relevant inputs, which are the price of the underlying asset, the strike price, the time to expiration, the risk-free rate, and the standard deviation of the return on the underlying asset.

3. The effect of changing the inputs into the Black-Scholes OPM varies. Some changes have positive effects; some have negative effects. The magnitude also varies; relatively small changes in the risk-free rate don't have much of an effect, but changes in the standard deviation can have a very large effect. These various effects are known as the *greeks* because of the Greek (and quasi-Greek) letters used to identify them.
4. The equity in a leveraged corporation can be viewed as a call option on the assets of the firm. This gives the stockholders a strong incentive to increase the volatility of the return on the firm's assets, even if that means accepting projects with lower NPVs.

CONNECT TO FINANCE



For more practice, you should be in *Connect Finance*. Log on to connect.mheducation.com to get started!

Can you answer the following Connect Quiz questions?

- Section 25.1** What is the effective annual rate of 7.6 percent, compounded continuously?
- Section 25.3** A call option has a value of \$8.40. $N(d_1)$ is .32. Assume that the underlying stock increases in value by \$.50. What is the approximate amount of the resulting change in the call option value?
- Section 25.4** When using the put-call parity formula to compute the value of equity in a firm, the equity in the firm is represented by which one of the variables in the put-call parity formula?

CONCEPTS REVIEW AND CRITICAL THINKING QUESTIONS

1. **Options and Expiration Dates [LO3]** What is the impact of lengthening the time to expiration on an option's value? Explain.
2. **Options and Stock Price Volatility [LO3]** What impact does an increase in the volatility of the underlying stock's return have on an option's value? Explain.
3. **Options and Interest Rates [LO3]** How do interest rates affect option prices? Explain.
4. **Protective Puts [LO1]** The protective put strategy we discussed in the chapter is sometimes referred to as *stock price insurance*. Why?
5. **Intrinsic Value [LO2]** What is the intrinsic value of a call option? Of a put option? How do we interpret this value?
6. **Time Value [LO2]** What is the time value of a call option? Of a put option? What happens to the time value of a call option as the maturity increases? What about a put option?
7. **Option Valuation and NPV [LO5]** You are CEO of Titan Industries and have just been awarded a large number of employee stock options. The company has two mutually exclusive projects available. The first project has a large NPV and will reduce the total risk of the company. The second project has a small NPV and will increase the total risk of the company. You have decided to accept the first project when you remember your employee stock options. How might this affect your decision?

8. **Put-Call Parity [LO1]** You find a put and a call with the same exercise price and maturity. What do you know about the relative prices of the put and call? Prove your answer and provide an intuitive explanation.
9. **Put-Call Parity [LO1]** A put and a call have the same maturity and strike price. If they have the same price, which one is in the money? Prove your answer and provide an intuitive explanation.
10. **Put-Call Parity [LO1]** One thing put-call parity tells us is that given any three of a stock, a call, a put, and a T-bill, the fourth can be synthesized or replicated using the other three. For example, how can we replicate a share of stock using a call, a put, and a T-bill?

QUESTIONS AND PROBLEMS



1. **Continuous Compounding [LO2]** If you have \$1,275 today, how much will it be worth in six years at 8 percent per year compounded continuously?
2. **Continuous Compounding [LO2]** If you need \$20,000 in 12 years, how much will you need to deposit today if you can earn 9 percent per year compounded continuously?
3. **Put-Call Parity [LO1]** A stock is currently selling for \$67 per share. A call option with an exercise price of \$70 sells for \$3.21 and expires in three months. If the risk-free rate of interest is 2.6 percent per year, compounded continuously, what is the price of a put option with the same exercise price?
4. **Put-Call Parity [LO1]** A put option that expires in six months with an exercise price of \$45 sells for \$2.34. The stock is currently priced at \$48, and the risk-free rate is 3.5 percent per year, compounded continuously. What is the price of a call option with the same exercise price?
5. **Put-Call Parity [LO1]** A put option and a call option with an exercise price of \$70 and three months to expiration sell for \$1.30 and \$6.25, respectively. If the risk-free rate is 3.1 percent per year, compounded continuously, what is the current stock price?
6. **Put-Call Parity [LO1]** A put option and call option with an exercise price of \$50 expire in four months and sell for \$5.99 and \$8.64, respectively. If the stock is currently priced at \$52.27, what is the annual continuously compounded rate of interest?
7. **Black-Scholes [LO2]** What are the prices of a call option and a put option with the following characteristics?

Stock price = \$64
Exercise price = \$60
Risk-free rate = 2.7% per year, compounded continuously
Maturity = 4 months
Standard deviation = 62% per year

8. **Delta [LO2]** What are the deltas of a call option and a put option with the following characteristics? What does the delta of the option tell you?

Stock price = \$87
Exercise price = \$85
Risk-free rate = 4.3% per year, compounded continuously
Maturity = 9 months
Standard deviation = 46% per year

9. **Black-Scholes and Asset Value [LO4]** You own a lot in Key West, Florida, that is currently unused. Similar lots have recently sold for \$1,250,000. Over the past five years, the price of land in the area has increased 7 percent per year, with an annual standard deviation of 30 percent. A buyer has recently approached you and wants an option to buy the land in the next 12 months for \$1,500,000. The risk-free rate of interest is 5 percent per year, compounded continuously. How much should you charge for the option? 
10. **Black-Scholes and Asset Value [LO4]** In Problem 9, suppose you wanted the option to sell the land to the buyer in one year. Assuming all the facts are the same, describe the transaction that would occur today. What is the price of the transaction today?
11. **Time Value of Options [LO2]** You are given the following information concerning options on a particular stock:

Stock price = \$59
Exercise price = \$55
Risk-free rate = 2% per year, compounded continuously
Maturity = 6 months
Standard deviation = 54% per year

- a. What is the intrinsic value of the call option? Of the put option?
- b. What is the time value of the call option? Of the put option?
- c. Does the call or the put have the larger time value component? Would you expect this to be true in general?
12. **Put-Call Parity [LO1]** A call option with an exercise price of \$25 and four months to expiration has a price of \$2.75. The stock is currently priced at \$23.80, and the risk-free rate is 2.5 percent per year, compounded continuously. What is the price of a put option with the same exercise price?
13. **Black-Scholes [LO2]** A call option matures in six months. The underlying stock price is \$75, and the stock's return has a standard deviation of 20 percent per year. The risk-free rate is 4 percent per year, compounded continuously. If the exercise price is \$0, what is the price of the call option? INTERMEDIATE
(Questions 13–20)
14. **Black-Scholes [LO2]** A call option has an exercise price of \$60 and matures in six months. The current stock price is \$64, and the risk-free rate is 5 percent per year, compounded continuously. What is the price of the call if the standard deviation of the stock is 0 percent per year?
15. **Black-Scholes [LO2]** A stock is currently priced at \$47. A call option with an expiration of one year has an exercise price of \$50. The risk-free rate is 12 percent per year, compounded continuously, and the standard deviation of the stock's return is infinitely large. What is the price of the call option?
16. **Equity as an Option [LO4]** Sunburn Sunscreen has a zero coupon bond issue outstanding with a \$15,000 face value that matures in one year. The current market value of the firm's assets is \$16,200. The standard deviation of the return on the firm's assets is 34 percent per year, and the annual risk-free rate is 6 percent per year, compounded continuously. Based on the Black-Scholes model, what is the market value of the firm's equity and debt?
17. **Equity as an Option and NPV [LO4]** Suppose the firm in Problem 16 is considering two mutually exclusive investments. Project A has an NPV of \$1,900, and Project B

has an NPV of \$2,800. As the result of taking Project A, the standard deviation of the return on the firm's assets will increase to 46 percent per year. If Project B is taken, the standard deviation will fall to 29 percent per year.

- a. What is the value of the firm's equity and debt if Project A is undertaken? If Project B is undertaken?
 - b. Which project would the stockholders prefer? Can you reconcile your answer with the NPV rule?
 - c. Suppose the stockholders and bondholders are in fact the same group of investors. Would this affect your answer to (b)?
 - d. What does this problem suggest to you about stockholder incentives?
- ☒ 18. **Equity as an Option [LO4]** Frostbite Thermalwear has a zero coupon bond issue outstanding with a face value of \$23,000 that matures in one year. The current market value of the firm's assets is \$26,200. The standard deviation of the return on the firm's assets is 38 percent per year, and the annual risk-free rate is 6 percent per year, compounded continuously. Based on the Black-Scholes model, what is the market value of the firm's equity and debt? What is the firm's continuously compounded cost of debt?
19. **Mergers and Equity as an Option [LO5]** Suppose Sunburn Sunscreen and Frostbite Thermalwear in the previous problems have decided to merge. Because the two companies have seasonal sales, the combined firm's return on assets will have a standard deviation of 21 percent per year.
- a. What is the combined value of equity in the two existing companies? Value of debt?
 - b. What is the value of the new firm's equity? Value of debt?
 - c. What was the gain or loss for shareholders? For bondholders?
 - d. What happened to shareholder value here?
- ☒ 20. **Equity as an Option and NPV [LO4, 5]** A company has a single zero coupon bond outstanding that matures in five years with a face value of \$17.5 million. The current value of the company's assets is \$15.9 million, and the standard deviation of the return on the firm's assets is 41 percent per year. The risk-free rate is 6 percent per year, compounded continuously.
- a. What is the current market value of the company's equity?
 - b. What is the current market value of the company's debt?
 - c. What is the company's continuously compounded cost of debt?
 - d. The company has a new project available. The project has an NPV of \$2.2 million. If the company undertakes the project, what will be the new market value of equity? Assume volatility is unchanged.
 - e. Assuming the company undertakes the new project and does not borrow any additional funds, what is the new continuously compounded cost of debt? What is happening here?
21. **Debt Valuation and Time to Maturity [LO4]** Zevon Industries has a zero coupon bond issue that matures in two years with a face value of \$40,000. The current value of the company's assets is \$26,700, and the standard deviation of the return on assets is 60 percent per year.
- a. Assume the risk-free rate is 5 percent per year, compounded continuously. What is the value of a risk-free bond with the same face value and maturity as the company's bond?

CHALLENGE

(Questions 21–28)

- b. What price would the bondholders have to pay for a put option on the firm's assets with a strike price equal to the face value of the debt?
 - c. Using the answers from (a) and (b), what is the value of the firm's debt? What is the continuously compounded yield on the company's debt?
 - d. From an examination of the value of the assets of the company, and the fact that the debt must be repaid in two years, it seems likely that the company will default on its debt. Management has approached bondholders and proposed a plan whereby the company would repay the same face value of debt, but the repayment would not occur for five years. What is the value of the debt under the proposed plan? What is the new continuously compounded yield on the debt? Explain why this occurs.
- 22. Debt Valuation and Asset Variance [LO4]** Colosseum Corp. has a zero coupon bond that matures in five years with a face value of \$65,000. The current value of the company's assets is \$62,000, and the standard deviation of its return on assets is 34 percent per year. The risk-free rate is 7 percent per year, compounded continuously.
- a. What is the value of a risk-free bond with the same face value and maturity as the current bond?
 - b. What is the value of a put option on the firm's assets with a strike price equal to the face value of the debt?
 - c. Using the answers from (a) and (b), what is the value of the firm's debt? What is the continuously compounded yield on the company's debt?
 - d. Assume the company can restructure its assets so that the standard deviation of its return on assets increases to 43 percent per year. What happens to the value of the debt? What is the new continuously compounded yield on the debt? Reconcile your answers in (c) and (d).
 - e. What happens to bondholders if the company restructures its assets? What happens to shareholders? How does this create an agency problem?
- 23. Black-Scholes and Dividends [LO2]** In addition to the five factors discussed in the chapter, dividends also affect the price of an option. The Black-Scholes option pricing model with dividends is:
- $$C = S \times e^{-dt} \times N(d_1) - E \times e^{-Rt} \times N(d_2)$$
- $$d_1 = [\ln(S/E) + (R - d + \sigma^2/2) \times t] / (\sigma \times \sqrt{t})$$
- $$d_2 = d_1 - \sigma \times \sqrt{t}$$
- All of the variables are the same as the Black-Scholes model without dividends except for the variable d , which is the continuously compounded dividend yield on the stock.
- a. What effect do you think the dividend yield will have on the price of a call option? Explain.
 - b. A stock is currently priced at \$87 per share, the standard deviation of its return is 50 percent per year, and the risk-free rate is 4 percent per year, compounded continuously. What is the price of a call option with a strike price of \$85 and a maturity of six months if the stock has a dividend yield of 2 percent per year?
- 24. Put-Call Parity and Dividends [LO1]** The put-call parity condition is altered when dividends are paid. The dividend-adjusted put-call parity formula is:
- $$S \times e^{-dt} + P = E \times e^{-Rt} + C$$
- where d is again the continuously compounded dividend yield.

- a. What effect do you think the dividend yield will have on the price of a put option? Explain.
 - b. From Problem 23, what is the price of a put option with the same strike and time to expiration as the call option?
 - 25. **Put Delta [LO2]** In the chapter, we noted that the delta for a put option is $N(d_1) - 1$. Is this the same thing as $-N(-d_1)$? (*Hint:* Yes, but why?)
 - 26. **Black-Scholes Put Pricing Model [LO2]** Use the Black-Scholes model for pricing a call, put-call parity, and Problem 25 to show that the Black-Scholes model for directly pricing a put can be written as:
- $$P = E \times e^{-rt} \times N(-d_2) - S \times N(-d_1)$$
- 27. **Black-Scholes [LO2]** A stock is currently priced at \$50. The stock will never pay a dividend. The risk-free rate is 12 percent per year, compounded continuously, and the standard deviation of the stock's return is 60 percent. A European call option on the stock has a strike price of \$100 and no expiration date, meaning that it has an infinite life. Based on Black-Scholes, what is the value of the call option? Do you see a paradox here? Do you see a way out of the paradox?
 - 28. **Delta [LO2]** You purchase one call and sell one put with the same strike price and expiration date. What is the delta of your portfolio? Why?

EXCEL MASTER IT! PROBLEM



In addition to spinners and scroll bars, there are numerous other Controls in Excel. You need to build a Black-Scholes Option Pricing Model spreadsheet using several of these controls.

- a. Buttons are always used in sets. Using buttons permits you to check an option and the spreadsheet will use that input. In this case, you need to create two buttons, one for a call option and one for a put option. When using the spreadsheet, if you click the call option, the spreadsheet will calculate a call price and if you click the put option it will calculate the price of a put. Notice on the next spreadsheet that cell B20 is blank. This cell should change names. The names should be "Call option price" and "Put option price." In the price cell, only the price for the call option or put option is displayed depending on which button is selected. For the button, use the button under Form Controls.
- b. A Combo Box uses a drop down menu with values entered by the spreadsheet developer. One advantage of a Combo Box is that the user can either choose values from the drop down menu or enter another value. In this case, you want to create a Combo Box for the stock price and a separate Combo Box for the strike price. In the right-hand side of the spreadsheet, we have values for the drop down menu. The values for the drop down menu should be created in an array before the Combo Box is inserted. To create an ActiveX Combo Box, go to Developer, Insert, and select Combo Box from the ActiveX Controls menu. After you draw the Combo Box, right click on the box, select Properties, and enter the LinkedCell, which is the cell where you want the output displayed, and the ListFillRange, which is the range that contains the list of values you want displayed in the drop down menu.
- c. In contrast to a Combo Box, a List Box permits the user to scroll through a list of possible values that is predetermined by the spreadsheet developer. No other values

can be entered. You need to create a List Box for the interest rate using the interest rate array on the right-hand side of the spreadsheet. To insert a List Box, go to Developer, Insert, and choose the List Box from the ActiveX Controls. To enter the linked cell and array of values, you will need to go to the Properties for the List Box. To do this, right click on the List Box and select Properties from the menu. We should note here that to edit both the Combo Box and List box you need to make sure that Design Mode is checked on the Developer tab.

MINICASE

Exotic Cuisines Employee Stock Options

As a new graduate, you've taken a management position with Exotic Cuisines, Inc., a restaurant chain that just went public last year. The company's restaurants specialize in exotic main dishes, using ingredients such as alligator, bison, and ostrich. A concern you had going in was that the restaurant business is very risky. However, after some due diligence, you discovered a common misperception about the restaurant industry. It is widely thought that 90 percent of new restaurants close within three years; however, recent evidence suggests the failure rate is closer to 60 percent over three years. So, it is a risky business, although not as risky as you originally thought.

During your interview process, one of the benefits mentioned was employee stock options.

Upon signing your employment contract, you received options with a strike price of \$55 for 10,000 shares of company stock. As is fairly common, your stock options have a three-year vesting period and a 10-year expiration, meaning that you cannot exercise the options for a period of three years, and you lose them if you leave before they vest. After the three-year vesting period, you can exercise the options at any time. Thus, the employee stock options are European (and subject to forfeit) for the first three years and American afterward. Of course, you cannot sell the options, nor can you enter into any sort of hedging agreement. If you leave the company after the options vest, you must exercise within 90 days or forfeit any options that are not exercised.

Exotic Cuisines stock is currently trading at \$26.32 per share, a slight increase from the initial offering price last year. There are no market-traded options on the company's stock. Because the company has been traded for only about a year, you are reluctant to use the historical returns to estimate the standard deviation of the stock's return. However, you have estimated that the average annual standard deviation for restaurant company stocks is about 55 percent. Because Exotic Cuisines is a newer restaurant chain, you decide to use a 60 percent standard deviation in your calculations. The company is relatively young, and you expect that all earnings will be reinvested back into the company for the near future. Therefore, you expect no dividends will be paid for

at least the next 10 years. A 3-year Treasury note currently has a yield of 2.4 percent, and a 10-year Treasury note has a yield of 3.1 percent.

QUESTIONS

1. You're trying to value your options. What minimum value would you assign? What is the maximum value you would assign?
2. Suppose that, in three years, the company's stock is trading at \$60. At that time, should you keep the options or exercise them immediately? What are some important determinants in making such a decision?
3. Your options, like most employee stock options, are not transferable or tradable. Does this have a significant effect on the value of the options? Why?
4. Why do you suppose employee stock options usually have a vesting provision? Why must they be exercised shortly after you depart the company even after they vest?
5. A controversial practice with employee stock options is repricing. What happens is that a company experiences a stock price decrease, which leaves employee stock options far out of the money or "underwater." In such cases, many companies have "repriced" or "restruck" the options, meaning that the company leaves the original terms of the option intact, but lowers the strike price. Proponents of repricing argue that because the option is very unlikely to end in the money due to the stock price decline, the motivational force is lost. Opponents argue that repricing is in essence a reward for failure. How do you evaluate this argument? How does the possibility of repricing affect the value of an employee stock option at the time it is granted?
6. As we have seen, much of the volatility in a company's stock price is due to systematic or marketwide risks. Such risks are beyond the control of a company and its employees. What are the implications for employee stock options? In light of your answer, can you recommend an improvement over traditional employee stock options?

IN JUNE 2016, Microsoft made a splash in business social media when it announced plans to acquire LinkedIn for \$26.2 billion in cash. Microsoft CEO Satya Nadella stated that the combined companies could accelerate LinkedIn's growth. Microsoft also felt that LinkedIn could be incorporated into Office 365 and Dynamics, Microsoft's new platform to support accounting and financial applications.

So how do companies like Microsoft determine whether such acquisitions are worthwhile? This chapter explores the reasons why mergers and acquisitions take place and—equally important—the reasons why they should not.

Learning Objectives

After studying this chapter, you should be able to:

- LO1** Discuss the different types of mergers and acquisitions, why they should (or shouldn't) take place, and the terminology associated with them.
- LO2** Describe how accountants construct the combined balance sheet of the new company.
- LO3** Define the gains from a merger or acquisition and how to value the transaction.

©by LadrillStockPhoto/Gettyimages

For updates on the latest happenings in finance, visit fundamentals-of-corporate-finance.blogspot.com.

There is no more dramatic or controversial activity in corporate finance than the acquisition of one firm by another or the merger of two firms. It is the stuff of headlines in the financial press, and it is occasionally an embarrassing source of scandal. And there are a lot of mergers. During 2016, U.S. companies announced mergers and acquisitions valued at about \$642 billion, an 18 percent decline from the \$786 billion announced during 2015.

The acquisition of one firm by another is, of course, an investment made under uncertainty, and the basic principles of valuation apply. One firm should acquire another only if doing so generates a positive net present value for the shareholders of the acquiring firm. Because the NPV of an acquisition candidate can be difficult to determine, mergers and acquisitions, or M&A activities, are interesting topics in their own right.

Some of the special problems that come up in this area of finance include the following:

1. The benefits from acquisitions can depend on such things as strategic fits. Strategic fits are difficult to define precisely, and it is not easy to estimate the value of strategic fits using discounted cash flow techniques.
2. There can be complex accounting, tax, and legal effects that must be taken into account when one firm is acquired by another.
3. Acquisitions are an important control device for shareholders. Some acquisitions are a consequence of an underlying conflict between the interests of existing managers and those of shareholders. Agreeing to be acquired by another firm is one way that shareholders can remove existing managers.
4. Mergers and acquisitions sometimes involve “unfriendly” transactions. In such cases, when one firm attempts to acquire another, the activity does not always confine itself to quiet, genteel negotiations. The sought-after firm often resists takeover and may resort to defensive tactics with exotic names such as poison pills, greenmail, and white knights.

We discuss these and other issues associated with mergers in the sections that follow. We begin by introducing the basic legal, accounting, and tax aspects of acquisitions.

The Legal Forms of Acquisitions

26.1

There are three basic legal procedures that one firm can use to acquire another firm:

1. Merger or consolidation.
2. Acquisition of stock.
3. Acquisition of assets.

Although these forms are different from a legal standpoint, the financial press frequently does not distinguish between them. The term *merger* is often used regardless of the actual form of the acquisition.

In our discussion, we will frequently refer to the acquiring firm as the *bidder*. This is the company that offers to distribute cash or securities to obtain the stock or assets of another company. The firm that is sought (and perhaps acquired) is often called the *target firm*. The cash or securities offered to the target firm are the *consideration* in the acquisition.

MERGER OR CONSOLIDATION

A **merger** is the complete absorption of one firm by another. The acquiring firm retains its name and its identity, and it acquires all the assets and liabilities of the acquired firm. After a merger, the acquired firm ceases to exist as a separate business entity.

A **consolidation** is the same as a merger except that an entirely new firm is created. In a consolidation, both the acquiring firm and the acquired firm terminate their previous legal existence and become part of a new firm. For this reason, the distinction between the acquiring and the acquired firm is not as important in a consolidation as it is in a merger.

The rules for mergers and consolidations are basically the same. Acquisition by merger or consolidation results in a combination of the assets and liabilities of acquired and acquiring firms; the only difference lies in whether or not a new firm is created. We will henceforth use the term *merger* to refer generically to both mergers and consolidations.

There are some advantages and some disadvantages to using a merger to acquire a firm:

1. A primary advantage is that a merger is legally simple and does not cost as much as other forms of acquisition. The reason is that the firms agree to combine their entire

merger

The complete absorption of one company by another, wherein the acquiring firm retains its identity and the acquired firm ceases to exist as a separate entity.

consolidation

A merger in which an entirely new firm is created and both the acquired firm and the acquiring firm cease to exist.

operations. There is no need to transfer title to individual assets of the acquired firm to the acquiring firm.

2. A primary disadvantage is that a merger must be approved by a vote of the stockholders of each firm.¹ Typically, two-thirds (or even more) of the share votes are required for approval. Obtaining the necessary votes can be time-consuming and difficult. Furthermore, as we discuss in greater detail a bit later, the cooperation of the target firm's existing management is almost a necessity for a merger. This cooperation may not be easily or cheaply obtained.

ACQUISITION OF STOCK

A second way to acquire another firm is to purchase the firm's voting stock with an exchange of cash, shares of stock, or other securities. This process will often start as a private offer from the management of one firm to that of another.

Regardless of how it starts, at some point the offer is taken directly to the target firm's stockholders. This can be accomplished by a tender offer. A **tender offer** is a public offer to buy shares. It is made by one firm directly to the shareholders of another firm.

Those shareholders who choose to accept the offer tender their shares by exchanging them for cash or securities (or both), depending on the offer. A tender offer is frequently contingent on the bidder's obtaining some percentage of the total voting shares. If not enough shares are tendered, then the offer might be withdrawn or reformulated.

The tender offer is communicated to the target firm's shareholders by public announcements such as those made in newspaper advertisements. Sometimes, a general mailing is used in a tender offer. This is uncommon because a general mailing requires the names and addresses of the stockholders of record. Obtaining such a list without the target firm's cooperation is not easy.

The following are some factors involved in choosing between an acquisition by stock and a merger:

1. In an acquisition by stock, no shareholder meetings have to be held and no vote is required. If the shareholders of the target firm don't like the offer, they are not required to accept it and need not tender their shares.
2. In an acquisition by stock, the bidding firm can deal directly with the shareholders of the target firm by using a tender offer. The target firm's management and board of directors can be bypassed.
3. Acquisition is occasionally unfriendly. In such cases, a stock acquisition is used in an effort to circumvent the target firm's management, which is usually actively resisting acquisition. Resistance by the target firm's management often makes the cost of acquisition by stock higher than the cost of a merger.
4. Frequently, a significant minority of shareholders will hold out in a tender offer. The target firm cannot be completely absorbed when this happens, and this may delay realization of the merger benefits or may be costly in some other way. For example, if the bidder ends up with less than 80 percent of the target firm's shares, it must pay tax on 20 to 30 percent of any dividends paid by the target firm to the bidder.
5. Complete absorption of one firm by another requires a merger. Many acquisitions by stock are followed up with a formal merger later.

ACQUISITION OF ASSETS

A firm can effectively acquire another firm by buying most or all of its assets. This accomplishes the same thing as buying the company. In this case, the target firm will not

¹Mergers between corporations require compliance with state laws. In virtually all states, the shareholders of each corporation must give their assent.

tender offer

A public offer by one firm to directly buy the shares of another firm.



For up-to-date information about happenings in the world of M&A, go to www.marketwatch.com, then type "merger" into its search option.

necessarily cease to exist; it will have just sold off its assets. The “shell” will still exist unless its stockholders choose to dissolve it.

This type of acquisition requires a formal vote of the shareholders of the selling firm. One advantage to this approach is that there is no problem with minority shareholders holding out. However, the acquisition of assets may involve transferring titles to individual assets. The legal process of transferring assets can be costly.

ACQUISITION CLASSIFICATIONS

Financial analysts typically classify acquisitions into three types:

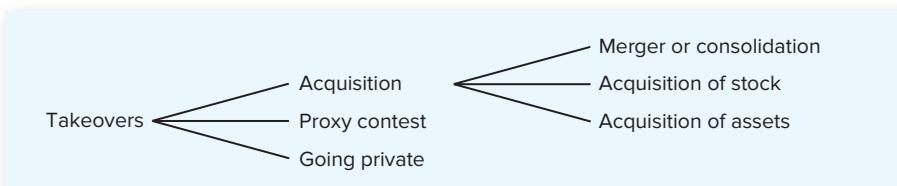
1. *Horizontal acquisition*: This is an acquisition of a firm in the same industry as the bidder. For example, in March 2016, Marriott International announced that it was acquiring competitor Starwood. And in January 2016, pharmaceutical company Shire announced that it was purchasing rival pharmaceutical company Baxalta.
2. *Vertical acquisition*: A vertical acquisition involves firms at different steps of the production process. For example, the Microsoft acquisition of LinkedIn, discussed at the beginning of the chapter, is a vertical acquisition, since Microsoft plans to integrate LinkedIn into its Office 365 platform. And in May 2016, chemical delivery systems maker Ichor Systems announced it was acquiring Ajax Custom Manufacturing, which makes plastic components used by Ichor.
3. *Conglomerate acquisition*: When the bidder and the target firm are in unrelated lines of business, the merger is called a conglomerate acquisition. Conglomerate acquisitions are popular in the technology area. For example, by 2016, Alphabet (formerly Google) had acquired more than 200 companies since 2003. So, while you may be familiar with Google’s Android operating system for cell phones, you may not be aware that Google acquired Android in 2005.



Got the urge to merge? See
www.firstlist.com and
www.dealstream.com
for ideas.

A NOTE ABOUT TAKEOVERS

Takeover is a general and imprecise term referring to the transfer of control of a firm from one group of shareholders to another. A takeover occurs whenever one group takes control from another.² This can occur through any one of three means: Acquisitions, proxy contests, and going-private transactions. Thus, takeovers encompass a broader set of activities than just acquisitions. These activities can be depicted as follows:



As we have mentioned before, a takeover achieved by acquisition will occur by merger, tender offer, or purchase of assets. In mergers and tender offers, the bidder buys the voting common stock of the target firm.

Takeovers can also occur with proxy contests. **Proxy contests** occur when a group attempts to gain controlling seats on the board of directors by voting in new directors. A *proxy* is the right to cast someone else’s votes. In a proxy contest, proxies are solicited by an unhappy group of shareholders from the rest of the shareholders.

proxy contest

An attempt to gain control of a firm by soliciting a sufficient number of stockholder votes to replace existing management.

²Having *control* may be defined as having a majority vote on the board of directors.

going-private transactions

Transactions in which all publicly owned stock in a firm is replaced with complete equity ownership by a private group.

leveraged buyouts (LBOs)

Going-private transactions in which a large percentage of the money used to buy the stock is borrowed. Often incumbent management is involved.

strategic alliance

Agreement between firms to cooperate in pursuit of a joint goal.

joint venture

Typically an agreement between firms to create a separate, co-owned entity established to pursue a joint goal.

In **going-private transactions**, all of the equity shares of a public firm are purchased by a small group of investors. Usually, the group includes members of incumbent management and some outside investors. Such transactions have come to be known generically as **leveraged buyouts (LBOs)** because a large percentage of the money needed to buy up the stock is usually borrowed. Such transactions are also termed *management buyouts* (MBOs) when existing management is heavily involved. The shares of the firm are delisted from stock exchanges and can no longer be purchased in the open market.

LBOs have become increasingly common, and some recent ones have been quite large. One of the largest cash acquisitions in history (and possibly the single largest private transaction ever of any kind) was the 2007 LBO of TXU Corp., the energy giant. The acquisition price in that buyout was an astonishing \$45 billion. In that LBO, as with most of the large ones, much of the financing came from junk bond sales (see Chapter 7 for a discussion of junk bonds).

ALTERNATIVES TO MERGER

Firms don't have to merge to combine their efforts. At a minimum, two (or more) firms can agree to work together. They can sell each other's products, perhaps under different brand names, or jointly develop a new product or technology. Firms will frequently establish a **strategic alliance**, which is usually a formal agreement to cooperate in pursuit of a joint goal. An even more formal arrangement is a **joint venture**, which commonly involves two firms putting up the money to establish a new firm. Verizon Wireless was originally a joint venture between Verizon Communications and Vodafone.

Concept Questions

26.1a What is a merger? How does a merger differ from other acquisition forms?

26.1b What is a takeover?

26.2 Taxes and Acquisitions

If one firm buys another firm, the transaction may be taxable or tax-free. In a *taxable acquisition*, the shareholders of the target firm are considered to have sold their shares, and they will have capital gains or losses that will be taxed. In a *tax-free acquisition*, the acquisition is considered an exchange instead of a sale, so no capital gain or loss occurs at the time of the transaction.

DETERMINANTS OF TAX STATUS

The general requirements for tax-free status are that the acquisition be for a business purpose, and not to avoid taxes, and that there be a continuity of equity interest. In other words, the stockholders in the target firm must retain an equity interest in the bidder.

The specific requirements for a tax-free acquisition depend on the legal form of the acquisition; but, in general, if the buying firm offers the selling firm cash for its equity, it will be a taxable acquisition. If shares of stock are offered, the transaction will generally be a tax-free acquisition.

In a tax-free acquisition, the selling shareholders are considered to have exchanged their old shares for new ones of equal value, so that no capital gains or losses are experienced.

TAXABLE VERSUS TAX-FREE ACQUISITIONS

There are two factors to consider when comparing a tax-free acquisition and a taxable acquisition: The capital gains effect and the write-up effect. The *capital gains effect* refers to the fact that the target firm's shareholders may have to pay capital gains taxes in a taxable acquisition. They may demand a higher price as compensation, thereby increasing the cost of the merger. This is a cost of a taxable acquisition.

The tax status of an acquisition also affects the appraised value of the assets of the selling firm. In a taxable acquisition, the assets of the selling firm are revalued or "written up" from their historic book value to their estimated current market value. This is the *write-up effect*, and it is important because it means that the depreciation expense on the acquired firm's assets can be increased in taxable acquisitions. Remember that an increase in depreciation is a noncash expense, but it has the desirable effect of reducing taxes.

The benefit from the write-up effect was sharply curtailed by the Tax Reform Act of 1986. The reason is that the increase in value from writing up the assets is now considered a taxable gain. Before this change, taxable mergers were much more attractive because the write-up was not taxed.

Concept Questions

- 26.2a** What factors influence the choice between a taxable and a tax-free acquisition?
- 26.2b** Under current tax law, why are taxable acquisitions less attractive than they once were?

Accounting for Acquisitions

26.3

In 2001, the Federal Accounting Standards Board (FASB) determined that the buyer had to treat all acquisitions under the *purchase accounting method*. Prior to 2001, firms were allowed to choose from more than one method. In all of this, keep in mind that we are examining purely accounting-related issues. How a merger is treated for financial reporting purposes has no cash flow consequences.

THE PURCHASE METHOD

The *purchase accounting method* of reporting acquisitions requires that the assets of the target firm be reported at their fair market value on the books of the bidder. With this method, an asset called *goodwill* is created for accounting purposes. Goodwill is the difference between the purchase price and the estimated fair market value of the net assets (assets less liabilities) acquired.

To illustrate, suppose Firm A acquires Firm B, thereby creating a new firm, AB. The balance sheets for the two firms on the date of the acquisition are shown in Table 26.1. Suppose Firm A pays **\$18 million** in cash for Firm B. The money is raised by borrowing the full amount. The net fixed assets of Firm B, which are carried on the books at **\$8 million**, are appraised at \$14 million fair market value. Because the working capital is **\$2 million**, the balance sheet assets are worth \$16 million. Firm A pays **\$2 million** in excess of the estimated market value of these net assets. This amount is the goodwill.³

³Remember, there are assets such as employee talents, good customers, growth opportunities, and other intangibles that don't show up on the balance sheet. The \$2 million excess pays for these.

TABLE 26.1
Accounting for Acquisitions: Purchase (in Millions)

	Firm A		Firm B		
Working capital	\$ 4	Equity	\$20	Working capital	\$ 2
Fixed assets	16			Fixed assets	8
Total	\$20	Total	\$20	Total	\$10
Firm AB					
Working capital	\$ 6	Debt	\$18		
Fixed assets	30	Equity	20		
Goodwill	2				
Total	\$38	Total	\$38		

The market value of the fixed assets of Firm B is \$14 million. Firm A pays **\$18 million** for Firm B by issuing debt.

The last balance sheet in Table 26.1 shows what the new firm looks like under purchase accounting. Notice that:

1. The total assets of Firm AB increase to **\$38 million**. The fixed assets increase to **\$30 million**. This is the sum of the fixed assets of Firm A and the revalued fixed assets of Firm B (**\$16 million + 14 million = \$30 million**).
2. The **\$2 million** excess of the purchase price over the fair market value is reported as goodwill on the balance sheet.⁴

MORE ABOUT GOODWILL

As we just discussed, the purchase method generally leads to the creation of an intangible asset called goodwill. Pre-2001 guidelines required firms to amortize this goodwill, meaning that a portion of it was deducted as an expense every year over some period of time. In essence, the goodwill, like any asset, had to be depreciated until it was completely written off.

Despite the cash flow irrelevance of goodwill amortization, FASB's decision to require purchase accounting caused a great deal of protest, much of it due to the treatment of goodwill and its impact on reported earnings. As a compromise, in 2001 FASB eliminated the requirement that goodwill be amortized and put in place a new rule. In essence, the new rule says that each year firms must assess the value of the goodwill on their balance sheets. If the value has gone down (or become "impaired" in accounting-speak), the firm must deduct the decrease; otherwise, no amortization is required.

Concept Questions

26.3a What is "goodwill"?

26.3b What happens to goodwill if the value of the acquisition declines over time?

⁴You might wonder what would happen if the purchase price were less than the estimated fair market value. Amusingly, to be consistent, it seems that the accountants would need to create a liability called *ill will!* Instead, the fair market value is revised downward to equal the purchase price.

Gains from Acquisitions

26.4

To determine the gains from an acquisition, we need to first identify the relevant incremental cash flows, or, more generally, the source of value. In the broadest sense, acquiring another firm makes sense only if there is some concrete reason to believe that the target firm will somehow be worth more in our hands than it is worth by itself. As we will see, there are a number of reasons why this might be so.

SYNERGY

Suppose Firm A is contemplating acquiring Firm B. The acquisition will be beneficial if the combined firm will have greater value than the sum of the values of the separate firms. If we let V_{AB} stand for the value of the merged firm, then the merger makes sense only if:

$$V_{AB} > V_A + V_B$$

where V_A and V_B are the separate values. A successful merger requires that the value of the whole exceed the sum of the parts.

The difference between the value of the combined firm and the sum of the values of the firms as separate entities is the incremental net gain from the acquisition, ΔV :

$$\Delta V = V_{AB} - (V_A + V_B)$$

When ΔV is positive, the acquisition is said to generate **synergy**. For example, when Comcast announced its intention to acquire Time Warner Cable in early 2014, the company estimated that the savings in operating expenses would be \$750 million the first year and would eventually reach \$1.5 billion.

If Firm A buys Firm B, it gets a company worth V_B plus the incremental gain, ΔV . The value of Firm B to Firm A (V_B^*) is:

$$\text{Value of Firm B to Firm A} = V_B^* = \Delta V + V_B$$

We place an * on V_B^* to emphasize that we are referring to the value of Firm B to Firm A, not the value of Firm B as a separate entity.

V_B^* can be determined in two steps: (1) Estimating V_B and (2) estimating ΔV . If B is a public company, then its market value as an independent firm under existing management (V_B) can be observed directly. If Firm B is not publicly owned, then its value will have to be estimated based on similar companies that are publicly owned. Either way, the problem of determining a value for V_B^* requires determining a value for ΔV .

To determine the incremental value of an acquisition, we need to know the incremental cash flows. These are the cash flows for the combined firm less what A and B could generate separately. In other words, the incremental cash flow for evaluating a merger is the difference between the cash flow of the combined company and the sum of the cash flows for the two companies considered separately. We will label this incremental cash flow as ΔCF .



Visit www.thedeal.com for current news about mergers.

synergy

The positive incremental net gain associated with the combination of two firms through a merger or acquisition.

Synergy

EXAMPLE 26.1

Firms A and B are competitors with very similar assets and business risks. Both are all-equity firms with aftertax cash flows of \$10 per year forever, and both have an overall cost of capital of 10 percent. Firm A is thinking of buying Firm B. The aftertax cash flow from the merged firm would be \$21 per year. Does the merger generate synergy? What is V_B^* ? What is ΔV ?

The merger does generate synergy because the cash flow from the merged firm is $\Delta CF = \$1$ greater than the sum of the individual cash flows ($\$21$ versus $\$20$). Assuming the risks stay the same, the value of the merged firm is $\$21/.10 = \210 . Firms A and B are each worth $\$10/.10 = \100 , for a total of $\$200$. The incremental gain from the merger, ΔV , is $\$210 - 200 = \10 . The total value of Firm B to Firm A, V_B^* , is $\$100$ (the value of B as a separate company) plus $\$10$ (the incremental gain), or $\$110$.

From our discussions in earlier chapters, we know that the incremental cash flow, ΔCF , can be broken down into four parts:

$$\begin{aligned}\Delta CF &= \Delta EBIT + \Delta Depreciation + \Delta Tax - \Delta Capital requirements \\ &= \Delta Revenue - \Delta Cost - \Delta Tax - \Delta Capital requirements\end{aligned}$$

where $\Delta Revenue$ is the difference in revenues, $\Delta Cost$ is the difference in costs, ΔTax is the difference in taxes, and $\Delta Capital requirements$ is the change in new fixed assets and net working capital.

Based on this breakdown, the merger will make sense only if one or more of these cash flow components are beneficially affected by the merger. The possible cash flow benefits of mergers and acquisitions fall into four basic categories: Revenue enhancement, cost reductions, lower taxes, and reductions in capital needs.

REVENUE ENHANCEMENT

One important reason for an acquisition is that the combined firm may generate greater revenues than two separate firms. Increases in revenue may come from marketing gains, strategic benefits, and increases in market power.

Marketing Gains It is frequently claimed that mergers and acquisitions can produce greater operating revenues from improved marketing. Improvements might be made in the following areas:

1. Previously ineffective media programming and advertising efforts.
2. A weak existing distribution network.
3. An unbalanced product mix.

For example, in March 2016, paint-maker Sherwin-Williams announced a bid for competitor Valspar. Sherwin-Williams stated that it expected to save $\$280$ million per year within two years from lower sourcing costs; lower selling, general, and administrative costs; and process and efficiency savings. The long-term goal was to achieve synergies of $\$320$ million per year.

Strategic Benefits Some acquisitions promise a strategic advantage. This is an opportunity to take advantage of the competitive environment if certain things occur or, more generally, to enhance management flexibility with regard to the company's future operations. In this latter sense, a strategic benefit is more like an option than a standard investment opportunity.

Suppose a computer manufacturer can use its technology to enter other businesses. The electronics and software technology from the original business can provide opportunities to begin manufacturing consumer electronics (think Apple).

The word *beachhead* has been used to describe the process of entering a new industry to exploit perceived opportunities. The beachhead is used to spawn new opportunities based on "intangible" relationships. One example is Procter & Gamble's initial acquisition of the Charmin Paper Company as a beachhead, which allowed P&G to develop a highly

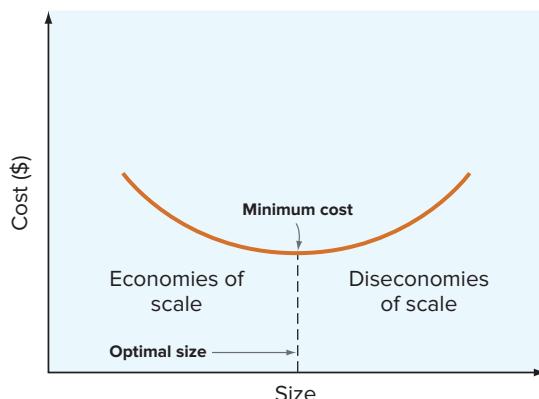
interrelated cluster of paper products—disposable diapers, paper towels, feminine hygiene products, and bathroom tissue.⁵

Increases in Market Power One firm may acquire another to increase its market share and market power. In such mergers, profits can be enhanced through higher prices and reduced competition for customers. Of course, mergers that substantially reduce competition in the market may be challenged by the U.S. Department of Justice or the Federal Trade Commission on antitrust grounds.

COST REDUCTIONS

One of the most basic reasons to merge is that a combined firm may operate more efficiently than two separate firms. A firm can achieve greater operating efficiency in several different ways through a merger or an acquisition.

Economies of Scale Economies of scale relate to the average cost per unit of producing goods and services. As illustrated below, if the per-unit cost of production falls as the level of production increases, then an economy of scale exists.



Frequently, the phrase *spreading overhead* is used in connection with economies of scale. This expression refers to the sharing of central facilities such as corporate headquarters, top management, and computer services. For example, in April 2008, when Delta Air Lines and Northwest Airlines announced a merger agreement, the companies issued a statement that they expected to generate cost synergies from more effective aircraft utilization, a more comprehensive and diversified route system, and savings from reduced overhead and improved operational efficiency.

Economies of Vertical Integration Operating economies can be gained from vertical combinations as well as from horizontal combinations. The main purpose of vertical acquisitions is to make it easier to coordinate closely related operating activities. Benefits from vertical integration are probably why most forest product firms that cut timber also own sawmills and hauling equipment. Economies of vertical integration may explain why some airline companies have purchased hotels and car rental companies.

⁵This example comes from Michael Porter, *Competitive Advantage* (New York: Free Press, 1985).

Technology transfers are another reason for vertical integration. Very frequently, a company will decide that the cheapest—and fastest—way to acquire another firm's technological skills is to buy the firm. For obvious reasons, this rationale is particularly common in high-tech industries.

Complementary Resources Some firms acquire others to make better use of existing resources or to provide the missing ingredient for success. Think of a ski equipment store that could merge with a tennis equipment store to produce more even sales over both the winter and summer seasons, thereby better using store capacity.

LOWER TAXES

Tax gains are a powerful incentive for some acquisitions. The possible tax gains from an acquisition include the following:

1. The use of tax losses.
2. The use of unused debt capacity.
3. The use of surplus funds.
4. The ability to write up the value of depreciable assets.

Net Operating Losses Firms that lose money on a pretax basis will not pay taxes. Such firms can end up with tax losses they cannot use. These tax losses are referred to as *net operating losses* (NOL).

A firm with net operating losses may be an attractive merger partner for a firm with significant tax liabilities. Absent any other effects, the combined firm will have a lower tax bill than the two firms considered separately. This is a good example of how a firm can be more valuable merged than standing alone.

There are two qualifications to our NOL discussion:

1. Federal tax laws permit firms that experience periods of profit and loss to even things out through loss carryforward provisions (carrybacks were eliminated by the Tax Cuts and Jobs Act of 2017). Thus, a merger to exploit unused tax shields must offer tax savings over and above what can be accomplished by firms via carryforwards.
2. The IRS may disallow an acquisition if the principal purpose of the acquisition is to avoid federal tax by acquiring a deduction or credit that would not otherwise be available.

Unused Debt Capacity Some firms do not use as much debt as they are able. This makes them potential acquisition candidates. Adding debt can provide important tax savings, and many acquisitions are financed with debt. The acquiring company can deduct interest payments on the newly created debt and reduce taxes (subject to limits created by the Tax Cuts and Jobs Act of 2017, which we discussed elsewhere).

Surplus Funds Another quirk in the tax laws involves surplus funds. Consider a firm that has free cash flow—cash flow available after all taxes have been paid and after all positive net present value projects have been financed. In such a situation, aside from

purchasing fixed-income securities, the firm has several ways to spend the free cash flow, including:

1. Paying dividends.
2. Buying back its own shares.
3. Acquiring shares in another firm.

We discussed the first two options in an earlier chapter. We saw that an extra dividend will increase the income tax paid by some investors. A share repurchase will reduce the taxes paid by shareholders as compared to paying dividends, but this is not a legal option if the sole purpose is to avoid taxes that otherwise would have been paid by shareholders.

To avoid these problems, the firm can buy another firm. By doing this, the firm avoids the tax problem associated with paying a dividend. Also, the dividends received from the purchased firm are not taxed in a merger.

Asset Write-Ups We have previously observed that, in a taxable acquisition, the assets of the acquired firm can be revalued. If the value of the assets increases, the tax deductions for depreciation will be a benefit; but this benefit will usually be more than offset by taxes due on the write-up.

REDUCTIONS IN CAPITAL NEEDS

All firms must invest in working capital and fixed assets to sustain an efficient level of operating activity. A merger may reduce the combined investments needed by the two firms. For example, Firm A may need to expand its manufacturing facilities, whereas Firm B may have significant excess capacity. It may be much cheaper for Firm A to buy Firm B than to build from scratch.

In addition, acquiring firms may see ways of more effectively managing existing assets. This can occur with a reduction in working capital resulting from more efficient handling of cash, accounts receivable, and inventory. Finally, the acquiring firm may also sell off certain assets that are not needed in the combined firm.

Firms will often cite many reasons for merging. Typically, when firms agree to merge, they generate a list of the economic benefits that shareholders can expect from the merger. For example, the U.S. Steel and Marathon Oil agreement stated (emphasis added):

U.S. Steel believes that the acquisition of Marathon provides U.S. Steel with an attractive opportunity to *diversify* into the energy business. Reasons for the merger include, but are not limited to, the facts that consummation of the merger will allow U.S. Steel to consolidate Marathon in U.S. Steel's federal *income tax return*, will also contribute to *greater efficiency*, and will enhance the *ability to manage capital* by permitting movements of cash between U.S. Steel and Marathon. Additionally, the merger will *eliminate the possibility of conflicts of interest* between the interests of minority and majority shareholders and will *enhance management flexibility*. The acquisition will provide Marathon shareholders with a substantial premium over historic market prices for their shares. However, [Marathon] shareholders will no longer continue to share in the future prospects of the company.

The more recent merger of satellite radio providers XM and Sirius is another good example. In the middle of 2008, the market capitalization of Sirius was about \$3.2 billion and the market capitalization of XM was about \$2.5 billion. Analysts estimated that the merger could result in cost savings with a present value of between \$3 to \$7 billion, potentially

more than the combined market cap of the two companies! Why were the estimated savings so large? The companies gave a lot of reasons:

1. Operating cost savings across the board:
 - a. General and administrative costs.
 - b. Sales and marketing costs.
 - c. Subscriber acquisition costs.
 - d. Research and development costs.
 - e. Product development, manufacturing, and inventory costs.
 - f. Programming operating infrastructure.
2. Additional shareholder value in the longer term due to savings on satellite fleet, terrestrial infrastructure, and other capital cost redundancies.
3. Greater appeal to large national advertisers that have a significant number of media alternatives.
4. Advertising sales expense savings.
5. Enhanced operating leverage resulting in accelerated free cash flow generation.

AVOIDING MISTAKES

Evaluating the benefit of a potential acquisition is more difficult than a standard capital budgeting analysis because so much of the value can come from intangible, or otherwise difficult to quantify, benefits. Consequently, there is a great deal of room for error. Here are some general rules that should be remembered:

1. *Do not ignore market values:* There is no point to, and little gain from, estimating the value of a publicly traded firm when that value can be directly observed. The current market value represents a consensus opinion of investors concerning the firm's value (under existing management). Use this value as a starting point. If the firm is not publicly held, then the place to start is with similar firms that are publicly held.
2. *Estimate only incremental cash flows:* It is important to estimate the incremental cash flows that will result from the acquisition. Only incremental cash flows from an acquisition will add value to the acquiring firm. Acquisition analysis should focus only on the newly created, incremental cash flows from the proposed acquisition.
3. *Use the correct discount rate:* The discount rate should be the required rate of return for the incremental cash flows associated with the acquisition. It should reflect the risk associated with the use of funds, not the source. In particular, if Firm A is acquiring Firm B, then Firm A's cost of capital is not particularly relevant. Firm B's cost of capital is a much more appropriate discount rate because it reflects the risk of Firm B's cash flows.
4. *Be aware of transactions costs:* An acquisition may involve substantial (and sometimes astounding) transactions costs. These will include fees to investment bankers, legal fees, and disclosure requirements.

A NOTE ABOUT INEFFICIENT MANAGEMENT

There are firms whose value could be increased with a change in management. These are firms that are poorly run or otherwise do not efficiently use their assets to create shareholder value. Mergers are a means of replacing management in such cases.

The fact that a firm might benefit from a change in management does not necessarily mean that existing management is dishonest, incompetent, or negligent. Instead, as some athletes are better than others, so might some management teams be better at running a business. This can be particularly true during times of technological change or other periods when innovations in

business practice are occurring. In any case, to the extent that corporate “raiders” can identify poorly run firms or firms that, for other reasons, will benefit from a change in management, these raiders provide a valuable service to target firm shareholders and society in general.

Concept Questions

- 26.4a** What are the relevant incremental cash flows for evaluating a merger candidate?
26.4b What are some different sources of gains from acquisitions?

Some Financial Side Effects of Acquisitions

26.5

In addition to the various possibilities we have discussed thus far, mergers can have some purely financial side effects—that is, things that occur regardless of whether the merger makes economic sense or not. Two such effects are particularly worth mentioning: EPS growth and diversification.

EPS GROWTH

An acquisition can create the appearance of growth in earnings per share, or EPS. This may fool investors into thinking that the firm is doing better than it really is. What happens is easiest to see with an example.

Suppose Global Resources, Ltd., acquires Regional Enterprises. The financial positions of Global and Regional before the acquisition are shown in Table 26.2. We assume that the merger creates no additional value, so the combined firm (Global Resources after acquiring Regional) has a value that is equal to the sum of the values of the two firms before the merger.

Before the merger, both Global and Regional have 100 shares outstanding. However, Global sells for \$25 per share, versus a price of \$10 per share for Regional. Global acquires Regional by exchanging 1 of its shares for every 2.5 shares in Regional. Because there are 100 shares in Regional, this will take $100/2.5 = 40$ shares in all.

After the merger, Global will have 140 shares outstanding, and several things will happen (see the third column of Table 26.2):

1. The market value of the combined firm is **\$3,500**. This is equal to the sum of the values of the separate firms before the merger. If the market is “smart,” it will realize that the combined firm is worth the sum of the values of the separate firms.

	Global Resources before Merger	Regional Enterprises before Merger	Global Resources after Merger	
			The Market Is Smart	The Market Is Fooled
Earnings per share	\$1	\$1	\$1.43	\$1.43
Price per share	\$25	\$10	\$25	\$35.71
Price-earnings ratio	25	10	17.5	25
Number of shares	100	100	140	140
Total earnings	\$100	\$100	\$200	\$200
Total value	\$2,500	\$1,000	\$3,500	\$5,000

TABLE 26.2
Financial Positions of Global Resources and Regional Enterprises

Exchange ratio: 1 share in Global for 2.5 shares in Regional.

2. The earnings per share of the merged firm are **\$1.43**. The acquisition enables Global to increase its earnings per share from \$1 to \$1.43, an increase of 43 percent.
3. Because the stock price of Global after the merger is the same as before the merger, the price-earnings ratio must fall. This is true as long as the market is smart and recognizes that the total market value has not been altered by the merger.

If the market is “fooled,” it might mistake the 43 percent increase in earnings per share for true growth. In this case, the price-earnings ratio of Global may not fall after the merger. Suppose the price-earnings ratio of Global remains equal to 25. Because the combined firm has earnings of **\$200**, the total value of the combined firm will increase to **\$5,000** ($= 25 \times \200). The per-share value for Global will increase to **\$35.71** ($= \$5,000/140$).

This is earnings growth magic. Like all good magic, it is illusion. For it to work, the shareholders of Global and Regional must receive something for nothing. This, of course, is unlikely with so simple a trick.

DIVERSIFICATION

Diversification is commonly mentioned as a benefit of a merger. We previously noted that U.S. Steel included diversification as a benefit in describing its acquisition of Marathon Oil. The problem is that diversification per se probably does not create value.

Going back to Chapter 13, recall that diversification reduces unsystematic risk. We also saw that the value of an asset depends on its systematic risk, and systematic risk is not directly affected by diversification. Because the unsystematic risk is not especially important, there is no particular benefit from reducing it.

An easy way to see why diversification isn’t an important benefit of a merger is to consider someone who owned stock in U.S. Steel and Marathon Oil. Such a stockholder was already diversified between these two investments. The merger didn’t do anything the stockholders couldn’t do for themselves.

More generally, stockholders can get all the diversification they want by buying stock in different companies. As a result, they won’t pay a premium for a merged company for the benefit of diversification.

By the way, we are not saying that U.S. Steel made a mistake. At the time of the merger, U.S. Steel was a cash-rich company (over 20 percent of its assets were in the form of cash and marketable securities). It is not uncommon to see firms with surplus cash articulating a “need” for diversification.

Concept Questions

26.5a Why can a merger create the appearance of earnings growth?

26.5b Why is diversification by itself not a good reason for a merger?

26.6 The Cost of an Acquisition

We’ve discussed some of the benefits of acquisition. We now need to discuss the cost of a merger.⁶ We learned earlier that the net incremental gain from a merger is:

$$\Delta V = V_{AB} - (V_A + V_B)$$

⁶For a more complete discussion of the costs of a merger and the NPV approach, see S. C. Myers, “A Framework for Evaluating Mergers,” in *Modern Developments in Financial Management*, ed. S. C. Myers (New York: Praeger Publishers, 1976).

Also, the total value of Firm B to Firm A, V_B^* , is:

$$V_B^* = V_B + \Delta V$$

The net present value (NPV) of the merger is:

$$\text{NPV} = V_B^* - \text{Cost to Firm A of the acquisition}$$

To illustrate, suppose we have the following premerger information for Firm A and Firm B:

	Firm A	Firm B
Price per share	\$ 20	\$ 10
Number of shares	25	10
Total market value	\$500	\$100

Both of these firms are 100 percent equity. You estimate that the incremental value of the acquisition, ΔV , is \$100.

The board of Firm B has indicated that it will agree to a sale if the price is \$150, payable in cash or stock. This price for Firm B has two parts. Firm B is worth \$100 as a stand-alone, so this is the minimum value that we could assign to Firm B. The second part, \$50, is called the merger premium, and it represents the amount paid above the stand-alone value.

Should Firm A acquire Firm B? Should it pay in cash or stock? To answer, we need to determine the NPV of the acquisition under both alternatives. We can start by noting that the value of Firm B to Firm A is:

$$\begin{aligned} V_B^* &= \Delta V + V_B \\ &= \$100 + 100 = \$200 \end{aligned}$$

The total value received by A as a result of buying Firm B is \$200. The question then is: How much does Firm A have to give up? The answer depends on whether cash or stock is used as the means of payment.

CASE I: CASH ACQUISITION

The cost of an acquisition when cash is used is the cash itself. So, if Firm A pays \$150 in cash to purchase all of the shares of Firm B, the cost of acquiring Firm B is \$150. The NPV of a cash acquisition is:

$$\begin{aligned} \text{NPV} &= V_B^* - \text{Cost} \\ &= \$200 - 150 = \$50 \end{aligned}$$

The acquisition is profitable.

After the merger, Firm AB will still have 25 shares outstanding. The value of Firm A after the merger is:

$$\begin{aligned} V_{AB} &= V_A + (V_B^* - \text{Cost}) \\ &= \$500 + 200 - 150 \\ &= \$550 \end{aligned}$$

This is the premerger value of \$500 plus the \$50 NPV. The price per share after the merger is $\$550/25 = \22 , representing a gain of \$2 per share.

CASE II: STOCK ACQUISITION

Things are somewhat more complicated when stock is the means of payment. In a cash merger, the shareholders in B receive cash for their stock; and, as in the U.S. Steel-Marathon

26.1

Oil example, they no longer participate in the company. As we have seen, the cost of the acquisition in this case is the amount of cash needed to pay off Firm B's stockholders.

In a stock merger, no cash actually changes hands. Instead, the shareholders of Firm B come in as new shareholders in the merged firm. The value of the merged firm in this case will be equal to the premerger values of Firms A and B plus the incremental gain from the merger, ΔV :

$$\begin{aligned}V_{AB} &= V_A + V_B + \Delta V \\&= \$500 + 100 + 100 \\&= \$700\end{aligned}$$

To give \$150 worth of stock for Firm B, Firm A will have to give up $\$150/\$20 = 7.5$ shares. After the merger, there will be $25 + 7.5 = 32.5$ shares outstanding, and the per-share value will be $\$700/32.5 = \21.54 .

Notice that the per-share price after the merger is lower under the stock purchase option. The reason has to do with the fact that B's shareholders own stock in the new firm.

It appears that Firm A paid \$150 for Firm B. However, it actually paid more than that. When all is said and done, B's stockholders own 7.5 shares of stock in the merged firm. After the merger, each of these shares is worth \$21.54. The total value of the consideration received by B's stockholders is $7.5 \times \$21.54 = \161.54 .

This \$161.54 is the true cost of the acquisition because it is what the sellers actually end up receiving. The NPV of the merger to Firm A is:

$$\begin{aligned}NPV &= V_B^* - Cost \\&= \$200 - 161.54 = \$38.46\end{aligned}$$

We can check this by noting that Firm A started with 25 shares worth \$20 each. The gain to Firm A of \$38.46 works out to be $\$38.46/25 = \1.54 per share. The value of the stock has increased to \$21.54, as we calculated.

When we compare the cash acquisition to the stock acquisition, we see that the cash acquisition is better in this case, because Firm A gets to keep all of the NPV if it pays in cash. If it pays in stock, Firm B's stockholders share in the NPV by becoming new stockholders in Firm A.

CASH VERSUS COMMON STOCK

The distinction between cash and common stock financing in a merger is an important one. If cash is used, the cost of an acquisition is not dependent on the acquisition gains. All other things being the same, if common stock is used, the cost is higher because Firm A's shareholders must share the acquisition gains with the shareholders of Firm B. However, if the NPV of the acquisition is negative, then the loss will be shared between the two firms.

Whether a firm should finance an acquisition with cash or with shares of stock depends on several factors, including the following:

1. *Sharing gains:* If cash is used to finance an acquisition, the selling firm's shareholders will not participate in the potential gains from the merger. Of course, if the acquisition is not a success, the losses will not be shared, and shareholders of the acquiring firm will be worse off than if stock had been used.
2. *Taxes:* Acquisition by paying cash usually results in a taxable transaction. Acquisition by exchanging stock is generally tax-free.
3. *Control:* Acquisition by paying cash does not affect the control of the acquiring firm. Acquisition with voting shares may have implications for control of the merged firm.

In a typical year, in terms of the total number of deals, cash financing is much more common than stock financing. The same is usually true based on the total dollar values, though the difference is smaller. The reason is that stock financing becomes more common if we look at very large deals.

Concept Questions

- 26.6a** Why does the true cost of a stock acquisition depend on the gain from the merger?
- 26.6b** What are some important factors in deciding whether to use stock or cash in an acquisition?

Defensive Tactics

26.7

Target firm managers frequently resist takeover attempts. Resistance usually starts with press releases and mailings to shareholders that present management's viewpoint. It can eventually lead to legal action and solicitation of competing bids. Managerial action to defeat a takeover attempt may make target firm shareholders better off if it elicits a higher offer premium from the bidding firm or another firm.

Of course, management resistance may reflect pursuit of self-interest at the expense of shareholders. This is a controversial subject. At times, management resistance has greatly increased the amount ultimately received by shareholders. At other times, management resistance appears to have defeated all takeover attempts to the detriment of shareholders.

In this section, we describe various defensive tactics that have been used by target firms' management to resist unfriendly attempts. The law surrounding these defenses is not settled, and some of these maneuvers may ultimately be deemed illegal or otherwise unsuitable.

THE CORPORATE CHARTER

The *corporate charter* consists of the articles of incorporation and corporate bylaws that establish the governance rules of the firm. The corporate charter establishes the conditions that allow for a takeover. Firms frequently amend corporate charters to make acquisitions more difficult. For example, usually two-thirds (67 percent) of the shareholders of record must approve a merger. Firms can make it more difficult to be acquired by changing this required percentage to 80 percent or so. Such a change is called a *supermajority amendment*.

Another device is to stagger the election of the board members. This makes it more difficult to elect a new board of directors quickly. Such a board is sometimes called a *classified board*. We discussed staggered elections in Chapter 8.

REPURCHASE AND STANDSTILL AGREEMENTS

Managers of target firms may attempt to negotiate *standstill agreements*. Standstill agreements are contracts wherein the bidding firm agrees to limit its holdings in the target firm. These agreements usually lead to the end of a takeover attempt.

Standstill agreements often occur at the same time that a *targeted repurchase* is arranged. In a targeted repurchase, a firm buys a certain amount of its own stock from an individual investor, usually at a substantial premium. These premiums can be thought of as payments to potential bidders to eliminate unfriendly takeover attempts. Critics of such payments view them as bribes and label them **greenmail**.

greenmail

In a targeted stock repurchase, payments made to potential bidders to eliminate unfriendly takeover attempts.

POISON PILLS AND SHARE RIGHTS PLANS

poison pill

A financial device designed to make unfriendly takeover attempts unappealing, if not impossible.

share rights plans

Provisions allowing existing stockholders to purchase stock at some fixed price should an outside takeover bid come up, discouraging hostile takeover attempts.

A **poison pill** is a tactic designed to repel would-be suitors. The term comes from the world of espionage. Agents are supposed to bite a pill of cyanide rather than permit capture. Presumably, this prevents enemy interrogators from learning important secrets.

In the equally colorful world of corporate finance, a poison pill is a financial device designed to make it impossible for a firm to be acquired without management's consent—unless the buyer is willing to commit financial suicide.

A majority of the largest firms in the United States have adopted poison pill provisions of one form or another, often calling them **share rights plans** (SRPs) or something similar. SRPs differ quite a bit in detail from company to company; we will describe a kind of generic approach here. In general, when a company adopts an SRP, it distributes share rights to its existing stockholders.⁷ These rights allow shareholders to buy shares of stock (or preferred stock) at some fixed price.

The rights issued with an SRP have a number of unusual features. First, the exercise, or subscription, price on the right is usually set high enough so that the rights are well out of the money, meaning that the purchase price is much higher than the current stock price. The rights will often be good for 10 years, and the purchase, or exercise, price is usually a reasonable estimate of what the stock will be worth at the end of that time.

In addition, unlike ordinary stock rights, these rights can't be exercised immediately, and they can't be bought and sold separately from the stock. Also, they can essentially be canceled by management at any time; often, they can be redeemed (bought back) for a penny apiece, or some similarly trivial amount.

Things get interesting when, under certain circumstances, the rights are “triggered.” This means that the rights become exercisable, they can be bought and sold separately from the stock, and they are not easily canceled or redeemed. Typically, the rights will be triggered when someone acquires 20 percent of the common stock or announces a tender offer.

When the rights are triggered, they can be exercised. Because they are out of the money, this fact is not especially important. Certain other features come into play, however. The most important is the *flip-in provision*.

The flip-in provision is the “poison” in the pill. In the event of an unfriendly takeover attempt, the holder of a right can pay the exercise price and receive common stock in the target firm worth twice the exercise price. In other words, holders of the rights can buy stock in the target firm at half price. Simultaneously, the rights owned by the raider (the acquirer) are voided. The goal of the flip-in provision is to massively dilute the raider's ownership position.⁸ Doing so greatly increases the cost of the merger to the bidder because the target firm's shareholders end up with a much larger percentage of the merged firm.

Notice that the flip-in provision doesn't prevent someone from acquiring control of a firm by purchasing a majority interest. It just acts to vastly increase the cost of doing so.

The intention of a poison pill is to force a bidder to negotiate with management. Frequently, merger offers are made with the contingency that the rights will be canceled by the target firm.

⁷We discussed ordinary share rights in Chapter 15.

⁸Some plans also contain “flip-over” provisions. These allow the holders to buy stock in the merged company at half price.

Some new varieties of poison pills have appeared on the scene in recent years. For example, a “chewable” pill, common in Canada but not in the United States, is a pill that is installed by shareholder vote and can be redeemed by shareholder vote. Then there’s the “deadhand pill,” which explicitly gives the directors who installed the pill, or their handpicked successors, the authority to remove the pill. This type of pill is controversial because it makes it virtually impossible for new directors elected by stockholders to remove an existing poison pill.

Recently, a method of circumventing poison pills has grown in popularity. Hedge funds or other large investors, all of whom have the same agenda, such as removing the company’s management or changing the way the company operates, band together and purchase a large block of stock. They then vote to remove the board of directors and company management without triggering the poison pill provision.

GOING PRIVATE AND LEVERAGED BUYOUTS

As we have previously discussed, going private is what happens when the publicly owned stock in a firm is replaced with complete equity ownership by a private group, which may include elements of existing management. As a consequence, the firm’s stock is taken off the market (if it is an exchange-traded stock, it is delisted) and no longer traded.

One result of going private is that takeovers via tender offer can no longer occur because there are no publicly held shares. In this sense, a leveraged buyout (or more specifically, a management buyout, or MBO) can be a takeover defense. However, it’s a defense only for management. From the stockholders’ point of view, an LBO is a takeover because they are bought out.

OTHER DEVICES AND JARGON OF CORPORATE TAKEOVERS

As corporate takeovers have become more common, a new vocabulary has developed. The terms are colorful, and, in no particular order, some of them are listed here:

1. *Golden parachute*: Some target firms provide compensation to top-level managers if a takeover occurs. For example, when Verizon agreed to acquire Yahoo! in 2016, it was reported that Yahoo! CEO Marissa Mayer would receive a \$57 million severance package if she left the company. The opposite of a golden parachute is a “golden handcuff,” which is an incentive package designed to get executives to stay on board once the acquisition is completed.

Depending on your perspective and the amounts involved, golden parachutes can be viewed as a payment to management to make it less concerned for its own welfare and more interested in stockholders when considering a takeover bid.

2. *Poison put*: A poison put is a variation on the poison pill we described earlier. A poison put forces the firm to buy securities back at some set price.
3. *Crown jewel*: Firms often sell or threaten to sell major assets—crown jewels—when faced with a takeover threat. This is sometimes referred to as the *scorched earth* strategy. This tactic often involves a lockup, which we discuss shortly.
4. *White knight*: A firm facing an unfriendly merger offer might arrange to be acquired by a different, friendly firm. The firm is thereby rescued by a “white knight.” Alternatively, the firm may arrange for a friendly entity to acquire a large block of stock. White knights can often increase the amount offered for the target firm. For example, in 2016, *Los Angeles Times* and *Chicago Tribune* publisher Tribune Publishing received a bid of \$12.25 per share from *USA Today* publisher Gannett Company. In response, Tribune Publishing found a white knight in Nant Capital, which invested \$70.5 million in new equity to help fight off the bid. Although Gannett increased its offer to \$15 per share, it eventually withdrew all offers and stopped its acquisition efforts.

So-called white squires or big brothers are individuals, firms, or even mutual funds involved in friendly transactions of these types. Sometimes white knights or others are granted exceptional terms or otherwise compensated. Inevitably, it seems, this has been called *whitemail*.

5. *Lockup*: A lockup is an option granted to a friendly suitor (a white knight, perhaps) giving it the right to purchase stock or some of the assets (the crown jewels, possibly) of a target firm at a fixed price in the event of an unfriendly takeover.
6. *Shark repellent*: A shark repellent is any tactic (a poison pill, for example) designed to discourage unwanted merger offers.
7. *Bear hug*: A bear hug is an unfriendly takeover offer designed to be so attractive that the target firm's management has little choice but to accept it. For example, in May 2016, Bayer made a \$62 billion bear hug offer for Monsanto. Evidently this bear hug wasn't tight enough because, in December 2016, Monsanto stockholders eventually agreed to a sale at \$66 billion.
8. *Fair price provision*: A fair price provision is a requirement that all selling shareholders receive the same price from a bidder. The provision prevents a "two-tier" offer. In such a deal, a bidder offers a premium price only for a percentage of the shares large enough to gain control. It offers a lower price for the remaining shares. Such an offer can set off a stampede among shareholders as they rush to get the better price.
9. *Dual class capitalization*: In an earlier chapter, we noted that some firms such as Alphabet have more than one class of common stock and that voting power is typically concentrated in a class of stock not held by the public. Such a capital structure means that an unfriendly bidder will not succeed in gaining control.
10. *Countertender offer*: Better known as the "Pac-Man" defense, the target responds to an unfriendly overture by offering to buy the bidder! This tactic is rarely used, in part because target firms are usually too small to realistically purchase the bidder. However, such a countertender offer occurred in 2013. Jos. A. Bank made an offer to acquire Men's Wearhouse, which turned down the offer. When Jos. A. Bank pulled the offer, Men's Wearhouse responded with a \$1.5 billion bid for Jos. A. Bank. Finally, after it was raised to \$2.3 billion, Jos. A. Bank accepted the offer in March 2014.

Concept Questions

26.7a What can a firm do to make a takeover less likely?

26.7b What is a share rights plan? Explain how the rights work.

26.8 Some Evidence on Acquisitions: Does M&A Pay?

One of the most controversial issues surrounding our subject is whether mergers and acquisitions benefit shareholders. A very large number of studies have attempted to estimate the effect of mergers and takeovers on stock prices of the bidding and target firms. These studies have examined the gains and losses in stock value around the time of merger announcements.

One conclusion that clearly emerges is that M&A pays for target firm shareholders. There is no mystery here. The premium typically paid by bidders represents an immediate, relatively large gain, often on the order of 20 percent or more.

Matters become much murkier when we look at bidders, and different studies reach different conclusions. One thing is clear: Shareholders in bidder firms seem to neither win nor lose very much, at least on average. This finding is a bit of a puzzle, and there are a variety of explanations:

1. Anticipated merger gains may not be completely achieved, and shareholders experience losses. This can happen if managers of bidding firms tend to overestimate the gains from acquisition.
2. The bidding firms are usually much larger than the target firms. Even though the dollar gains to the bidder may be similar to the dollar gains earned by shareholders of the target firm, the percentage gains will be much lower.
3. Another possible explanation for the low returns to the shareholders of bidding firms in takeovers is that management may not be acting in the interest of shareholders when it attempts to acquire other firms. Perhaps it is attempting to increase the size of the firm, even if this reduces its value per share.
4. The market for takeovers may be sufficiently competitive that the NPV of acquiring is zero because the prices paid in acquisitions fully reflect the value of the acquired firms. In other words, the sellers capture all of the gain.
5. Finally, the announcement of a takeover may not convey much new information to the market about the bidding firm. This can occur because firms frequently announce intentions to engage in merger “programs” long before they announce specific acquisitions. In this case, the stock price for the bidding firm may already reflect anticipated gains from mergers.

Concept Questions

26.8a What does the evidence say about the benefits of mergers and acquisitions to target company shareholders?

26.8b What does the evidence say about the benefits of mergers and acquisitions to acquiring company shareholders?

Divestitures and Restructurings

In contrast to a merger or acquisition, a **divestiture** occurs when a firm sells assets, operations, divisions, and/or segments to a third party. Note that divestitures are an important part of M&A activity. After all, one company’s acquisition is usually another’s divestiture. Also, following a merger, it is very common for certain assets or divisions to be sold. Such sales may be required by antitrust regulations; they may be needed to raise cash to help pay for a deal; or the divested units may be unwanted by the acquirer.

Divestitures also occur when a company decides to sell off a part of itself for reasons unrelated to mergers and acquisitions. This can happen when a particular unit is unprofitable or not a good strategic fit. Or, a firm may decide to cash out of a very profitable operation. Finally, a cash-strapped firm may have to sell assets to raise capital (this commonly occurs in bankruptcy).

A divestiture usually occurs like any other sale. A company lets it be known that it has assets for sale and seeks offers. If a suitable offer is forthcoming, a sale occurs.

In some cases, particularly when the desired divestiture is a relatively large operating unit, companies will elect to do an **equity carve-out**. To do a carve-out, a parent company

26.9

divestiture

The sale of assets, operations, divisions, and/or segments of a business to a third party.

equity carve-out

The sale of stock in a wholly owned subsidiary via an IPO.

first creates a completely separate company of which the parent is the sole shareholder. Next, the parent company arranges an initial public offering (IPO) in which a fraction, perhaps 20 percent or so, of the parent's stock is sold to the public, creating a publicly held company.

spin-off

The distribution of shares in a subsidiary to existing parent company stockholders.

Instead of a carve-out, a company can elect to do a **spin-off**. In a spin-off, the company distributes shares in the subsidiary to its existing stockholders on a pro rata basis. Shareholders can keep the shares or sell them as they see fit. Very commonly, a company will first do an equity carve-out to create an active market for the shares and then subsequently do a spin-off of the remaining shares at a later date. Many well-known companies were created by this route. For example, insurance giant Allstate was spun off by Sears; Agilent Technologies was a Hewlett-Packard spin-off; and Conoco was once a part of DuPont.

split-up

The splitting up of a company into two or more companies.

In a less common, but more drastic move, a company can elect to do (or be forced to do) a **split-up**. A split-up is exactly what the name suggests: A company splits itself into two or more new companies. Shareholders have their shares in the old company swapped for shares in the new companies. Probably the most famous split-up occurred in the 1980s. As the result of an antitrust suit by the Justice Department, AT&T was forced to split up through the creation of seven regional phone companies (the so-called Baby Bells). Today, the Baby Bells survive as companies such as Verizon. In an unusual turn of events, in 2005, SBC Communications acquired its former parent company, AT&T. In a nod to AT&T's history and name brand recognition, the new company kept the AT&T name even though SBC was the acquirer.

Split-ups are often touted as a way of "unlocking" value, meaning a situation where the whole is worth less than the sum of the parts. For example, in November 2016, Conoco-Phillips announced that it planned to spin off \$5 to \$8 billion of its assets related to natural gas production in the United States. Also in 2016, aluminum producer Alcoa announced that it would split into two companies. After the split, the name would be retained by the company that focused on smelting and refining, and the other company would be known as Arconic, Inc., and would focus on engineering products for the aerospace and automotive industries.

Concept Questions

26.9a What is an equity carve-out? Why might a firm wish to do one?

26.9b What is a split-up? Why might a firm choose to do one?

26.10 Summary and Conclusions

This chapter has introduced you to the extensive literature on mergers and acquisitions. We mentioned a number of issues:

1. *Forms of merger:* One firm can acquire another in several different ways. The three legal forms of acquisition are merger or consolidation, acquisition of stock, and acquisition of assets.
2. *Tax issues:* Mergers and acquisitions can be taxable or tax-free transactions. The primary issue is whether the target firm's stockholders sell or exchange their shares. Generally, a cash purchase will be a taxable merger, whereas a stock exchange will not be

taxable. In a taxable merger, there are capital gains effects and asset write-up effects to consider. In a stock exchange, the target firm's shareholders become shareholders in the merged firm.

3. *Accounting issues:* In 2001, FASB determined that all acquisitions must be treated under the purchase accounting method. As a result, a merger or acquisition will generally result in the creation of goodwill; but under the new guidelines, goodwill does not have to be amortized.
4. *Merger valuation:* If Firm A is acquiring Firm B, the benefits (ΔV) from the acquisition are defined as the value of the combined firm (V_{AB}) less the value of the firms as separate entities (V_A and V_B):

$$\Delta V = V_{AB} - (V_A + V_B)$$

The gain to Firm A from acquiring Firm B is the increased value of the acquired firm, ΔV , plus the value of Firm B as a separate firm, V_B . The total value of Firm B to Firm A, V_B^* , is:

$$V_B^* = \Delta V + V_B$$

An acquisition will benefit the shareholders of the acquiring firm if this value is greater than the cost of the acquisition.

The cost of an acquisition can be defined in general terms as the price paid to the shareholders of the acquired firm. The cost frequently includes a merger premium paid to the shareholders of the acquired firm. Moreover, the cost depends on the form of payment—that is, the choice between paying with cash or paying with common stock.

5. *Benefits:* The possible benefits of an acquisition come from several sources, including the following:
 - a. Revenue enhancement.
 - b. Cost reductions.
 - c. Lower taxes.
 - d. Reductions in capital needs.
6. *Defensive tactics:* Some of the most colorful language of finance comes from defensive tactics used in acquisition battles. *Poison pills*, *golden parachutes*, *crown jewels*, and *greenmail* are some of the terms that describe various antitakeover tactics.
7. *Effect on shareholders:* Mergers and acquisitions have been extensively studied. The basic conclusions are that, on average, the shareholders of target firms do well, whereas the shareholders of bidding firms do not appear to gain much.
8. *Divestitures:* For a variety of reasons, companies often wish to sell assets or operating units. For relatively large divestitures involving operating units, firms sometimes elect to do carve-outs, spin-offs, or split-ups.

CONNECT TO FINANCE



If you are using *Connect Finance* in your course, get online to take a Practice Test, check out study tools, and find out where you need additional practice.

Can you answer the following Connect Quiz questions?

- Section 26.2** What is one result of the Tax Reform Act of 1986?
- Section 26.3** When accounting for an acquisition, goodwill is the difference between what two things?
- Section 26.6** What factors should be considered when deciding whether an acquisition should be financed with cash or with shares of stock?

CHAPTER REVIEW AND SELF-TEST PROBLEMS

- 26.1 Merger Value and Cost** Consider the following information for two all-equity firms, Firm A and Firm B:

	Firm A	Firm B
Shares outstanding	2,000	6,000
Price per share	\$ 40	\$ 30

Firm A estimates that the value of the synergistic benefit from acquiring Firm B is \$6,000. Firm B has indicated that it would accept a cash purchase offer of \$35 per share. Should Firm A proceed?

- 26.2 Stock Mergers and EPS** Consider the following information for two all-equity firms, Firm A and Firm B:

	Firm A	Firm B
Total earnings	\$3,000	\$1,100
Shares outstanding	600	400
Price per share	\$ 70	\$ 15

Firm A is acquiring Firm B by exchanging 100 of its shares for all the shares in Firm B. What is the cost of the merger if the merged firm is worth \$63,000? What will happen to Firm A's EPS? Its PE ratio?

ANSWERS TO CHAPTER REVIEW AND SELF-TEST PROBLEMS

- 26.1** The total value of Firm B to Firm A is the premerger value of Firm B plus the \$6,000 gain from the merger. The premerger value of Firm B is $\$30 \times 6,000 = \$180,000$, so the total value is \$186,000. At \$35 per share, Firm A is paying $\$35 \times 6,000 = \$210,000$; the merger therefore has a negative NPV of $\$186,000 - 210,000 = -\$24,000$. At \$35 per share, Firm B is not an attractive merger partner.

- 26.2** After the merger, the firm will have 700 shares outstanding. Because the total value is \$63,000, the price per share is $\$63,000 / 700 = \90 , up from \$70. Because Firm B's stockholders end up with 100 shares in the merged firm, the cost of the merger is $100 \times \$90 = \$9,000$, not $100 \times \$70 = \$7,000$.

Also, the combined firm will have $\$3,000 + 1,100 = \$4,100$ in earnings, so EPS will be $\$4,100 / 700 = \5.86 , up from $\$3,000 / 600 = \5 . The old PE ratio was $\$70 / \$5 = 14.00$. The new one is $\$90 / \$5.86 = 15.37$.

CONCEPTS REVIEW AND CRITICAL THINKING QUESTIONS

1. **Merger Types [LO1]** In 2014, Japanese liquor company Suntory Holdings Ltd. acquired U.S. bourbon maker Beam Inc., for \$14 billion. Is this a horizontal or vertical acquisition? How do you suppose Beam's nationality affected Suntory's decision?
2. **Merger Terms [LO1]** Define each of the following terms:
 - a. Greenmail
 - b. White knight
 - c. Golden parachute
 - d. Crown jewels
 - e. Shark repellent
 - f. Corporate raider
 - g. Poison pill
 - h. Tender offer
 - i. Leveraged buyout (LBO)
3. **Merger Rationale [LO1]** Explain why diversification per se is probably not a good reason for a merger.
4. **Corporate Split [LO3]** In 2016, activist investor Elliott Management was pressuring Marathon Petroleum to split up the company. Elliott felt that Marathon should sell off its Speedway gas and retail stores. Why might investors prefer that a company split into multiple companies? Is there a possibility of reverse synergy?
5. **Poison Pills [LO1]** Are poison pills good or bad for stockholders? How do you think acquiring firms are able to get around poison pills?
6. **Mergers and Taxes [LO2]** Describe the advantages and disadvantages of a taxable merger as opposed to a tax-free exchange. What is the basic determinant of tax status in a merger? Would an LBO be taxable or nontaxable? Explain.
7. **Economies of Scale [LO3]** What does it mean to say that a proposed merger will take advantage of available economies of scale? Suppose Eastern Power Co. and Western Power Co. are located in different time zones. Both of them operate at 60 percent of capacity except for peak periods, when they operate at 100 percent of capacity. The peak periods begin at 9:00 a.m. and 5:00 p.m. local time and last about 45 minutes. Explain why a merger between Eastern and Western might make sense.
8. **Hostile Takeovers [LO1]** What types of actions might the management of a firm take to fight a hostile acquisition bid from an unwanted suitor? How do the target firm shareholders benefit from the defensive tactics of their management team? How are the target firm shareholders harmed by such actions? Explain.
9. **Merger Offers [LO1]** Suppose a company in which you own stock has attracted two takeover offers. Would it ever make sense for your company's management to favor the lower offer? Does the form of payment affect your answer at all?
10. **Merger Profit [LO2]** Acquiring firm stockholders seem to benefit very little from takeovers. Why is this finding a puzzle? What are some of the reasons offered in explanation?

QUESTIONS AND PROBLEMS



(Questions 1–8)

1. **Calculating Synergy [LO3]** Pearl, Inc., has offered \$228 million cash for all of the common stock in Jam Corporation. Based on recent market information, Jam is worth \$214 million as an independent operation. If the merger makes economic sense for Pearl, what is the minimum estimated value of the synergistic benefits from the merger?
2. **Balance Sheets for Mergers [LO2]** Consider the following premerger information about Firm X and Firm Y:

	Firm X	Firm Y
Total earnings	\$85,000	\$11,000
Shares outstanding	30,000	8,000
Per-share values:		
Market	\$ 58	\$ 13
Book	\$ 6	\$ 2

Assume that Firm X acquires Firm Y by issuing new long-term debt for all the shares outstanding at a merger premium of \$6 per share. Assuming that neither firm has any debt before the merger, construct the postmerger balance sheet for Firm X under the purchase accounting method.

3. **Balance Sheets for Mergers [LO2]** Assume that the following balance sheets are stated at book value. Suppose that Meat Co. purchases Loaf, Inc.

Meat Co.			
Current assets	\$18,000	Current liabilities	\$ 6,100
Net fixed assets	43,000	Long-term debt	13,700
Total	<u><u>\$61,000</u></u>	Equity	<u><u>41,200</u></u>

Loaf, Inc.			
Current assets	\$ 3,900	Current liabilities	\$ 1,500
Net fixed assets	6,900	Long-term debt	2,600
Total	<u><u>\$10,800</u></u>	Equity	<u><u>6,700</u></u>
		Total	<u><u>\$10,800</u></u>

The fair market value of Loaf's fixed assets is \$9,800 versus the \$6,900 book value shown. Meat pays \$17,800 for Loaf and raises the needed funds through an issue of long-term debt. Construct the postmerger balance sheet under the purchase accounting method.

4. **Balance Sheets for Mergers [LO2]** Silver Enterprises has acquired All Gold Mining in a merger transaction. Construct the balance sheet for the new corporation if the merger is treated as a purchase of interests for accounting purposes. The following balance sheets represent the premerger book values for both firms:

Silver Enterprises			
Current assets	\$ 5,700	Current liabilities	\$ 3,100
Other assets	1,600	Long-term debt	8,150
Net fixed assets	<u><u>18,400</u></u>	Equity	<u><u>14,450</u></u>
Total	<u><u>\$25,700</u></u>	Total	<u><u>\$25,700</u></u>

All Gold Mining			
Current assets	\$1,600	Current liabilities	\$1,590
Other assets	680	Long-term debt	0
Net fixed assets	<u>7,400</u>	Equity	<u>8,090</u>
Total	<u>\$9,680</u>	Total	<u>\$9,680</u>

The market value of All Gold Mining's fixed assets is \$9,300; the market values for current and other assets are the same as the book values. Assume that Silver Enterprises issues \$16,000 in new long-term debt to finance the acquisition.

5. **Cash versus Stock Payment [LO3]** Penn Corp. is analyzing the possible acquisition of Teller Company. Both firms have no debt. Penn believes the acquisition will increase its total aftertax annual cash flows by \$1.6 million indefinitely. The current market value of Teller is \$38 million, and that of Penn is \$65 million. The appropriate discount rate for the incremental cash flows is 10 percent. Penn is trying to decide whether it should offer 40 percent of its stock or \$51.5 million in cash to Teller's shareholders.
- What is the cost of each alternative?
 - What is the NPV of each alternative?
 - Which alternative should Penn choose?
6. **Calculating Synergy [LO3]** Three Guys Burgers, Inc., has offered \$16.5 million for all of the common stock in Two Guys Fries, Corp. The current market capitalization of Two Guys as an independent company is \$13.4 million. Assume the required return on the acquisition is 9 percent and the synergy from the acquisition is a perpetuity. What is the minimum annual synergy that Three Guys feels it will gain from the acquisition?
7. **EPS, PE, and Mergers [LO3]** The shareholders of Bread Company have voted in favor of a buyout offer from Butter Corporation. Information about each firm is given here:

	Bread	Butter
Price-earnings ratio	6.35	12.7
Shares outstanding	73,000	146,000
Earnings	\$230,000	\$690,000

Bread's shareholders will receive one share of Butter stock for every three shares they hold in Bread.

- What will the EPS of Butter be after the merger? What will the PE ratio be if the NPV of the acquisition is zero?
 - What must Butter feel is the value of the synergy between these two firms? Explain how your answer can be reconciled with the decision to go ahead with the takeover.
8. **Cash versus Stock as Payment [LO3]** Consider the following premerger information about a bidding firm (Firm B) and a target firm (Firm T). Assume that both firms have no debt outstanding.

	Firm B	Firm T
Shares outstanding	5,300	1,200
Price per share	\$ 44	\$ 16

Firm B has estimated that the value of the synergistic benefits from acquiring Firm T is \$9,300.

- a. If Firm T is willing to be acquired for \$19 per share in cash, what is the NPV of the merger?
 - b. What will the price per share of the merged firm be assuming the conditions in (a)?
 - c. In part (a), what is the merger premium?
 - d. Suppose Firm T is agreeable to a merger by an exchange of stock. If B offers one of its shares for every two of T's shares, what will the price per share of the merged firm be?
 - e. What is the NPV of the merger assuming the conditions in (d)?
- INTERMEDIATE** (Questions 9–13)
9. **Cash versus Stock as Payment [LO3]** In Problem 8, are the shareholders of Firm T better off with the cash offer or the stock offer? At what exchange ratio of B shares to T shares would the shareholders in T be indifferent between the two offers?
10. **Effects of a Stock Exchange [LO3]** Consider the following premerger information about Firm A and Firm B:

	Firm A	Firm B
Total earnings	\$4,350	\$1,300
Shares outstanding	1,600	400
Price per share	\$ 43	\$ 47

Assume that Firm A acquires Firm B via an exchange of stock at a price of \$49 for each share of B's stock. Both Firm A and Firm B have no debt outstanding.

- a. What will the earnings per share (EPS) of Firm A be after the merger?
 - b. What will Firm A's price per share be after the merger if the market incorrectly analyzes this reported earnings growth (that is, the price-earnings ratio does not change)?
 - c. What will the price-earnings ratio of the postmerger firm be if the market correctly analyzes the transaction?
 - d. If there are no synergy gains, what will the share price of Firm A be after the merger? What will the price-earnings ratio be? What does your answer for the share price tell you about the amount Firm A bid for Firm B? Was it too high? Too low? Explain.
11. **Merger NPV [LO3]** Show that the NPV of a merger can be expressed as the value of the synergistic benefits, ΔV , less the merger premium.
12. **Merger NPV [LO3]** Fly-By-Night Couriers is analyzing the possible acquisition of Flash-in-the-Pan Restaurants. Neither firm has debt. The forecasts of Fly-By-Night show that the purchase would increase its annual aftertax cash flow by \$375,000 indefinitely. The current market value of Flash-in-the-Pan is \$8.7 million. The current market value of Fly-By-Night is \$21 million. The appropriate discount rate for the incremental cash flows is 8 percent. Fly-By-Night is trying to decide whether it should offer 35 percent of its stock or \$12 million in cash to Flash-in-the-Pan.
- a. What is the synergy from the merger?
 - b. What is the value of Flash-in-the-Pan to Fly-By-Night?
 - c. What is the cost to Fly-By-Night of each alternative?
 - d. What is the NPV to Fly-By-Night of each alternative?
 - e. Which alternative should Fly-By-Night use?

- 13. Merger NPV [LO3]** Harrods PLC has a market value of £95 million and 4.5 million shares outstanding. Selfridge Department Store has a market value of £32 million and 1.8 million shares outstanding. Harrods is contemplating acquiring Selfridge. Harrods's CFO concludes that the combined firm with synergy will be worth £145 million, and Selfridge can be acquired at a premium of £3.3 million.
- If Harrods offers 1.1 million shares of its stock in exchange for the 1.8 million shares of Selfridge, what will the stock price of Harrods be after the acquisition?
 - What exchange ratio between the two stocks would make the value of a stock offer equivalent to a cash offer of £35.3 million?
- 14. Calculating NPV [LO3]** BQ, Inc., is considering making an offer to purchase iReport Publications. The vice president of finance has collected the following information:

CHALLENGE

(Question 14)

	BQ	iReport
Price-earnings ratio	14.5	9.2
Shares outstanding	1,400,000	195,000
Earnings	\$4,300,000	\$705,000
Dividends	\$1,075,000	\$375,000

BQ also knows that securities analysts expect the earnings and dividends of iReport to grow at a constant rate of 5 percent each year. BQ management believes that the acquisition of iReport will provide the firm with some economies of scale that will increase this growth rate to 7 percent per year.

- What is the value of iReport to BQ?
- What would BQ's gain be from this acquisition?
- If BQ were to offer \$38 in cash for each share of iReport, what would the NPV of the acquisition be?
- What's the most BQ should be willing to pay in cash per share for the stock of iReport?
- If BQ were to offer 205,000 of its shares in exchange for the outstanding stock of iReport, what would the NPV be?
- Should the acquisition be attempted? If so, should it be as in (c) or as in (e)?
- BQ's outside financial consultants think that the 7 percent growth rate is too optimistic and a 6 percent rate is more realistic. How does this change your previous answers?

MINICASE**The Birdie Golf–Hybrid Golf Merger**

Birdie Golf, Inc., has been in merger talks with Hybrid Golf Company for the past six months. After several rounds of negotiations, the offer under discussion is a cash offer of \$185 million for Hybrid Golf. Both companies have niche markets in the golf club industry, and both believe that a merger will result in synergies due to economies of scale in manufacturing and marketing, as well as significant savings in general and administrative expenses.

Bryce Bichon, the financial officer for Birdie, has been instrumental in the merger negotiations. Bryce has prepared the following pro forma financial statements for Hybrid Golf assuming the merger takes place. The financial statements include all synergistic benefits from the merger.

	2019	2020	2021	2022	2023
Sales	\$330,000,000	\$375,000,000	\$415,000,000	\$445,000,000	\$495,000,000
Production costs	231,000,000	262,500,000	290,500,000	311,500,000	346,500,000
Other expenses	33,000,000	38,000,000	41,000,000	45,000,000	49,000,000
Depreciation	<u>27,000,000</u>	<u>31,000,000</u>	<u>33,000,000</u>	<u>36,000,000</u>	<u>36,000,000</u>
EBIT	\$ 39,000,000	\$ 43,500,000	\$ 50,500,000	\$ 52,500,000	\$ 63,500,000
Interest	<u>7,500,000</u>	<u>9,000,000</u>	<u>10,000,000</u>	<u>10,500,000</u>	<u>11,000,000</u>
Taxable income	\$ 31,500,000	\$ 34,500,000	\$ 40,500,000	\$ 42,000,000	\$ 52,500,000
Taxes (21%)	<u>6,615,000</u>	<u>7,245,000</u>	<u>8,505,000</u>	<u>8,820,000</u>	<u>11,025,000</u>
Net income	<u>\$ 24,885,000</u>	<u>\$ 27,255,000</u>	<u>\$ 31,995,000</u>	<u>\$ 33,180,000</u>	<u>\$ 41,475,000</u>
Additions to retained earnings	0	\$ 16,000,000	\$ 19,000,000	\$ 21,000,000	\$ 25,000,000

If Birdie Golf buys Hybrid Golf, an immediate dividend of \$55 million would be paid from Hybrid Golf to Birdie. Stock in Birdie Golf currently sells for \$87 per share, and the company has 18 million shares of stock outstanding. Hybrid Golf has 8 million shares of stock outstanding. Both companies can borrow at an 8 percent interest rate. Bryce believes the current cost of capital for Birdie Golf is 11 percent. The cost of capital for Hybrid Golf is 12.4 percent, and the cost of equity is 16.9 percent. In five years, the value of Hybrid Golf is expected to be \$235 million.

Bryce has asked you to analyze the financial aspects of the potential merger. Specifically, he has asked you to answer the following questions.

QUESTIONS

1. Suppose Hybrid shareholders will agree to a merger price of \$23.13 per share. Should Birdie proceed with the merger?
2. What is the highest price per share that Birdie should be willing to pay for Hybrid?
3. Suppose Birdie is unwilling to pay cash for the merger but will consider a stock exchange. What exchange ratio would make the merger terms equivalent to the original merger price of \$23.13 per share?
4. What is the highest exchange ratio Birdie should be willing to pay and still undertake the merger?

HAVE YOU EVER FLOWN on GE Airlines? Probably not; but with about 2,000 aircraft, GE Capital Aviation Services (GECAS), part of GE, owns one of the largest aircraft fleets in the world. In fact, this arm of GE owns about \$40 billion in assets and generated about \$6.1 billion in profits during 2016. Overall, about 40 percent of all commercial jetliners worldwide are leased. So why is GECAS in the business of buying assets, only to lease them out? And why don't the companies that lease from GECAS purchase the assets themselves? This chapter answers these and other questions associated with leasing.

Learning Objectives

After studying this chapter, you should be able to:

- L01** Define the types of leases and how the IRS qualifies leases.
- L02** Explain the reasons for leasing and the reasons for not leasing.
- L03** Show how to calculate the net advantage of leasing and related issues.

©by_adri/StockPhoto/Gettyimages

For updates on the latest happenings in finance, visit fundamentals-of-corporate-finance.blogspot.com.

Leasing is a way businesses finance plant, property, and equipment.¹ Just about any asset that can be purchased can be leased, and there are many good reasons for leasing. For example, when we take vacations or business trips, renting a car for a few days is a convenient thing to do. After all, buying a car and selling it a week later would be a great nuisance. We discuss additional reasons for leasing in the sections that follow.

Although corporations engage in both short-term and long-term leasing, this chapter is primarily concerned with long-term leasing, where *long-term* typically means more than five years. As we will discuss in greater detail shortly, leasing an asset on a long-term basis is much like borrowing the needed funds and buying the asset. Thus, long-term leasing is a form of financing much like long-term debt. When is leasing preferable to long-term borrowing? This is a question we seek to answer in this chapter.



Up-to-date news and articles on the leasing industry are available at www.monitordaily.com.

¹We are indebted to James Johnson of Northern Illinois University for helpful comments and suggestions about this chapter.

27.1 Leases and Lease Types

lessee

The user of an asset in a leasing agreement. The lessee makes payments to the lessor.

lessor

The owner of an asset in a leasing agreement. The lessor receives payments from the lessee.

A **lease** is a contractual agreement between two parties: The **lessee** and the **lessor**. The lessee is the user of the equipment; the lessor is the owner. In the example we used to open the chapter, GE Capital Aviation Services is the lessor.

Typically, a company first decides what asset it needs. It then negotiates a lease contract with a lessor for use of that asset. The lease agreement establishes that the lessee has the right to use the asset and, in return, must make periodic payments to the lessor, the owner of the asset. The lessor is usually either the asset's manufacturer or an independent leasing company. If the lessor is an independent leasing company, it must buy the asset from a manufacturer. The lessor then delivers the asset to the lessee, and the lease goes into effect.

There are some giant lessors in the United States. For example, IBM Global Financing leases billions in equipment annually. Other major lessors include General Electric, International Lease Finance, and AirFleet Capital.

LEASING VERSUS BUYING

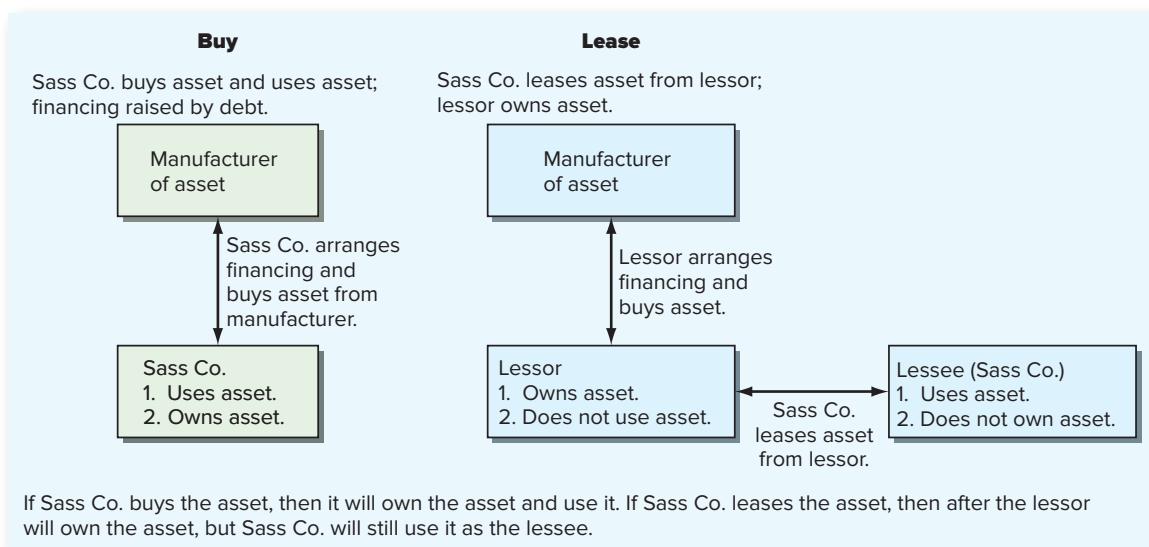
As far as the lessee is concerned, it is the use of the asset that is important, not necessarily who has title to it. One way to obtain the use of an asset is to lease it. Another way is to obtain outside financing and buy it. The decision to lease or buy amounts to a comparison of alternative financing arrangements for the use of an asset.

Figure 27.1 compares leasing and buying. The lessee, Sass Company, might be a hospital, a law firm, or any other firm that uses computers. The lessor is an independent leasing company that purchased the computer from a manufacturer such as Hewlett-Packard (HP). Leases of this type, in which the leasing company purchases the asset from the manufacturer, are called *direct leases*. Of course, HP might choose to lease its own computers; and



Should you lease or buy that next car? Visit MarketWatch at www.marketwatch.com for a calculator to help you decide.

FIGURE 27.1 Leasing versus Buying



many companies have set up wholly owned subsidiaries called *captive finance companies* to lease out their products.²

As shown in Figure 27.1, whether it leases or buys, Sass Company ends up using the asset. The key difference is that in one case (buy), Sass arranges the financing, purchases the asset, and holds title to the asset. In the other case (lease), the leasing company arranges the financing, purchases the asset, and holds title to the asset.

OPERATING LEASES

Years ago, a lease in which the lessee received an equipment operator along with the equipment was called an **operating lease**. Today, an operating lease (or *service lease*) is difficult to define precisely, but this form of leasing has several important characteristics.

First of all, with an operating lease, the payments received by the lessor are usually not enough to allow the lessor to fully recover the cost of the asset. A primary reason is that operating leases are often relatively short-term. Therefore, the life of the lease may be much shorter than the economic life of the asset. For example, if you lease a car for two years, the car will have a substantial residual value at the end of the lease, and the lease payments you make will pay off only a fraction of the original cost of the car. The lessor in an operating lease expects to either lease the asset again or sell it when the lease terminates.

A second characteristic of an operating lease is that it frequently requires that the lessor maintain the asset. The lessor also may be responsible for any taxes or insurance. Of course, these costs will be passed on, at least in part, to the lessee in the form of higher lease payments.

The third, and perhaps most interesting, feature of an operating lease is the cancellation option. This option can give the lessee the right to cancel the lease before the expiration date. If the option to cancel is exercised, the lessee returns the equipment to the lessor and ceases to make payments. The value of a cancellation clause depends on whether technological or economic conditions are likely to make the value of the asset to the lessee less than the present value of the future lease payments.

To leasing practitioners, these three characteristics define an operating lease. As we will see shortly, accountants use the term in a somewhat different way.

FINANCIAL LEASES

A **financial lease** is the other major type of lease. In contrast to the situation with an operating lease, the payments made under a financial lease (plus the anticipated residual, or salvage, value) are usually sufficient to fully cover the lessor's cost of purchasing the asset and pay the lessor a return on the investment. For this reason, a financial lease is sometimes said to be a fully amortized or full-payout lease, whereas an operating lease is said to be partially amortized. Financial leases are often called *capital leases* by accountants.

With a financial lease, the lessee (not the lessor) is usually responsible for insurance, maintenance, and taxes; for that reason, financial leases are often called *triple net leases*. A financial lease generally cannot be canceled, at least not without a significant penalty. In other words, the lessee must make the lease payments or face possible legal action.

The characteristics of a financial lease, particularly the fact that it is fully amortized, make it very similar to debt financing, so the name is a sensible one. There are three types of financial leases that are of particular interest: *Tax-oriented leases*, *leveraged leases*, and *sale and leaseback agreements*. We consider these next.

operating lease

Usually a shorter-term lease under which the lessor is responsible for insurance, taxes, and upkeep. May be cancelable by the lessee on short notice.



One website for equipment leasing is www.keystoneleasing.com.

financial lease

Typically a longer-term, fully amortized lease under which the lessee is responsible for maintenance, taxes, and insurance. Usually not cancelable by the lessee without penalty.

²In addition to arranging financing for asset users, captive finance companies (or subsidiaries) may purchase their parent company's products and provide debt or lease financing to the users. Ford Credit and Caterpillar Financial Services Corp. are examples of captive finance companies.

tax-oriented lease

A financial lease in which the lessor is the owner for tax purposes. Also called a *true lease* or a *tax lease*.

leveraged lease

A financial lease in which the lessor borrows a substantial fraction of the cost of the leased asset on a nonrecourse basis.

sale and leaseback

A financial lease in which the lessee sells an asset to the lessor and then leases it back.

Tax-Oriented Leases A lease in which the lessor is the owner of the leased asset for tax purposes is called a **tax-oriented lease**. Such leases are also called *tax leases* or *true leases*. In contrast, a *conditional sales agreement lease* is not a true lease. Here the lessee is the owner for tax purposes. Conditional sales agreement leases are really just secured loans. The financial leases we discuss in this chapter are all tax leases.

Tax-oriented leases make the most sense when the lessee is not in a position to efficiently use tax credits or depreciation deductions that come with owning the asset. By arranging for someone else to hold title, a tax lease passes these benefits on. The lessee can benefit because the lessor may return a portion of the tax benefits to the lessee in the form of lower lease payments.

Leveraged Leases A **leveraged lease** is a tax-oriented lease in which the lessor borrows a substantial portion of the purchase price of the leased asset on a *nonrecourse* basis, meaning that if the lessee defaults on the lease payments, the lessor does not have to keep making the loan payments. Instead, the lender must proceed against the lessee to recover its investment. In contrast, with a *single-investor lease*, if the lessor borrows to purchase the asset, the lessor remains responsible for the loan payments whether or not the lessee makes the lease payments. Leveraged leases can be quite complicated and are primarily used for big-ticket transactions.

Sale and Leaseback Agreements A **sale and leaseback** occurs when a company sells an asset it owns to another party and simultaneously leases it back. In a sale and leaseback, two things happen:

1. The lessee receives cash from the sale of the asset.
2. The lessee continues to use the asset.

Often, with a sale and leaseback, the lessee may have the option to repurchase the leased asset at the end of the lease.

Sale and leaseback arrangements have multiplied during recent years. For example, in October 2017, Albertsons posted a \$720 million gain from the sale and leaseback of 71 company owned stores. In June of that year, Finnish rental equipment company Ramirent executed the sale and leaseback of the company's operating facility for €15 million.

Concept Questions

- 27.1a** What are the differences between an operating lease and a financial lease?
- 27.1b** What is a tax-oriented lease?
- 27.1c** What is a sale and leaseback agreement?

27.2 Accounting and Leasing

Before November 1976, leasing was frequently called *off-balance-sheet financing*. As the name implies, a firm could arrange to use an asset through a lease and not necessarily disclose the existence of the lease contract on the balance sheet. Lessees had to report information about leasing activity only in the footnotes to their financial statements.

In November 1976, the Financial Accounting Standards Board (FASB) issued its *Statement of Financial Accounting Standards No. 13* (FASB 13), "Accounting for Leases." The basic idea of FASB 13 is that certain financial leases must be "capitalized." Essentially,

A. Balance Sheet with Purchase (The company finances a \$100,000 truck with debt.)			
Truck	\$100,000	Debt	\$100,000
Other assets	<u>100,000</u>	Equity	<u>100,000</u>
Total assets	<u><u>\$200,000</u></u>	Total debt plus equity	<u><u>\$200,000</u></u>
B. Balance Sheet with Operating Lease (The company finances the truck with an operating lease.)			
Truck	\$ 0	Debt	\$ 0
Other assets	<u>100,000</u>	Equity	<u>100,000</u>
Total assets	<u><u>\$100,000</u></u>	Total debt plus equity	<u><u>\$100,000</u></u>
C. Balance Sheet with Capital Lease (The company finances the truck with a capital lease.)			
Assets under capital lease	\$100,000	Obligations under capital lease	\$100,000
Other assets	<u>100,000</u>	Equity	<u>100,000</u>
Total assets	<u><u>\$200,000</u></u>	Total debt plus equity	<u><u>\$200,000</u></u>

TABLE 27.1
Leasing and the Balance Sheet

In the first case, a \$100,000 truck is purchased with debt. In the second case, an operating lease is used; no balance sheet entries are created. In the third case, a capital (financial) lease is used; the lease payments are capitalized as a liability, and the leased truck appears as an asset.

this requirement means that the present value of the lease payments must be calculated and reported along with debt and other liabilities on the right-hand side of the lessee's balance sheet. The same amount must be shown as the capitalized value of leased assets on the left-hand side of the balance sheet. Operating leases are not disclosed on the balance sheet except in the footnotes. Exactly what constitutes a financial or operating lease for accounting purposes will be discussed in just a moment.

Beginning in 2019, companies will be required to disclose operating leases on their balance sheets, which is a major change. The implication is that most leases will be reported on the balance sheet, so off-balance-sheet financing will be largely eliminated (at least from leasing activities).

To illustrate why the issue of off-balance-sheet financing is important, take a look at Table 27.1. The firm has \$100,000 in assets and no debt, which implies that the equity is also \$100,000. The firm needs a truck costing \$100,000, which it can lease or buy. The top of the table (Part A) shows the balance sheet assuming that the firm borrows the money and buys the truck.

If the firm leases the truck, then one of two things will happen. If the lease is an operating lease, then the balance sheet under the current rules will look like the one in Part B of the table. In this case, neither the asset (the truck) nor the liability (the present value of the lease payments) appears. If the lease is a capital lease, then the balance sheet will look more like the one in Part C of the table, where the truck is shown as an asset and the present value of the lease payments is shown as a liability.³

Beginning in 2019, whether the lease is classified as operating or financial will become less important. In both cases, the balance sheet will look like Part C of the table (with some minor differences due to accounting nitty-gritty).

³In Part C, we have made the simplifying assumption that the present value of the lease payments under the capital lease is equal to the cost of the truck. In general, the lessee must report the lesser of the present value of the lease payment stream or the cost of the equipment under lease.

For accounting purposes, a lease is declared to be a capital lease if at least one of the following criteria is met:

1. The lease transfers ownership of the property to the lessee by the end of the term of the lease.
2. The lessee has an option to purchase the asset that is relatively certain to be used.
3. The lease term is for a major part of the economic life of the asset.
4. The present value of the lease payments plus any other residual value equals or exceeds the value of the asset.
5. The asset is so specialized that it is expected to have no alternative use to the lessor at the end of the lease.

If one or more of the five criteria are met, the lease is a capital lease; otherwise, it is an operating lease for accounting purposes.

Concept Questions

27.2a What is meant by the term “off-balance-sheet” financing?

27.2b For accounting purposes, what constitutes a capital lease?

27.3 Taxes, the IRS, and Leases

The lessee can deduct lease payments for income tax purposes if the lease is deemed to be a true lease by the Internal Revenue Service (IRS). The tax shields associated with lease payments are critical to the economic viability of a lease, so IRS guidelines are an important consideration. Essentially, the IRS requires that a lease be primarily for business purposes and not merely for purposes of tax avoidance.

In broad terms, a lease is a contract that gives the lessee the right to control the use of a specific asset for a set period of time in exchange for payments made to the lessor. The lessee has the “right to control” if, during the lease, the lessee:

1. Has the right to essentially all the economic benefits from the use of the asset, and
2. Has the right to direct the use of the asset.

The IRS is concerned about lease contracts because leases sometimes appear to be set up solely to defer taxes. To see how this could happen, suppose that a firm plans to purchase a \$1 million bus that has a five-year life for depreciation purposes. Assume that straight-line depreciation to a zero salvage value is used. The depreciation expense would be \$200,000 per year. Now, suppose the firm can lease the bus for \$500,000 per year for two years and buy the bus for \$1 at the end of the two-year term. The present value of the tax benefits is clearly less if the bus is bought than if the bus is leased. The speedup of lease payments greatly benefits the firm and basically gives it a form of accelerated depreciation. In this case, the IRS might decide that the primary purpose of the lease is to defer taxes and disallow the tax treatment.

Concept Questions

27.3a Why is the IRS concerned about leasing?

27.3b What are some standards the IRS uses in evaluating a lease?

The Cash Flows from Leasing

27.4

To begin our analysis of the leasing decision, we need to identify the relevant cash flows. The first part of this section illustrates how this is done. A key point, and one to watch for, is that taxes are a very important consideration in a lease analysis. Also, while the changes to lease accounting coming in 2019 impact both the balance sheet and (potentially) income statement for reporting purposes, they do not generally affect leasing cash flows.

THE INCREMENTAL CASH FLOWS

Consider the decision confronting the Tasha Corporation, which manufactures pipe. Business has been expanding, and Tasha currently has a five-year backlog of pipe orders for the Trans-Missouri Pipeline.

The International Boring Machine Corporation (IBMC) makes a pipe-boring machine that can be purchased for \$10,000. Tasha has determined that it needs a new machine, and the IBMC model will save Tasha \$6,000 per year in reduced electricity bills for the next five years.

Tasha has a corporate tax rate of 21 percent. For simplicity, we assume that five-year straight-line depreciation will be used for the pipe-boring machine; after five years, the machine will be worthless. Johnson Leasing Corporation has offered to lease the same pipe-boring machine to Tasha for lease payments of \$2,500 paid at the end of each of the next five years. With the lease, Tasha would remain responsible for maintenance, insurance, and operating expenses.⁴

Susan Smart has been asked to compare the direct incremental cash flows from leasing the IBMC machine to the cash flows associated with buying it. The first thing she realizes is that, because Tasha will get the machine either way, the \$6,000 savings will be realized whether the machine is leased or purchased. Thus, this cost savings, and any other operating costs or revenues, can be ignored in the analysis.

Upon reflection, Ms. Smart concludes that there are only three important cash flow differences between leasing and buying:⁵

1. If the machine is leased, Tasha must make a lease payment of \$2,500 each year. However, lease payments are fully tax deductible, so the aftertax lease payment would be $\$2,500 \times (1 - .21) = \$1,975$. This is a cost of leasing instead of buying.
2. If the machine is leased, Tasha does not own it and cannot depreciate it for tax purposes. The depreciation would be $\$10,000/5 = \$2,000$ per year. A \$2,000 depreciation deduction generates a tax shield of $\$2,000 \times .21 = \420 per year. Tasha loses this valuable tax shield if it leases, so this is a cost of leasing.
3. If the machine is leased, Tasha does not have to spend **\$10,000** today to buy it. This is a benefit from leasing.

The cash flows from leasing instead of buying are summarized in Table 27.2. Notice that the cost of the machine shows up with a positive sign in Year 0. This is a reflection of the fact that Tasha *saves* the initial \$10,000 equipment cost by leasing instead of buying.

⁴We have assumed that all lease payments are made in arrears—that is, at the end of the year. Actually, many leases require payments to be made at the beginning of the year.

⁵There is a fourth consequence of leasing that we do not discuss here. If the machine has a nontrivial residual value, then, if we lease, we give up that residual value. This is another cost of leasing instead of buying.

TABLE 27.2

Incremental Cash Flows for Tasha Corp. from Leasing Instead of Buying

Lease versus Buy	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Aftertax lease payment		-\$1,975	-\$1,975	-\$1,975	-\$1,975	-\$1,975
Lost depreciation tax shield		- 420	- 420	- 420	- 420	- 420
Cost of machine	+\$10,000					
Total cash flow	+\$10,000	-\$2,395	-\$2,395	-\$2,395	-\$2,395	-\$2,395

A NOTE ABOUT TAXES

Susan Smart has assumed that Tasha can use the tax benefits of the depreciation allowances and the lease payments. This may not always be the case. If Tasha were losing money, it would not pay taxes, and the tax shelters would be worthless (unless they could be shifted to someone else). As we mentioned before, this is one circumstance under which leasing may make a great deal of sense. If this were the case, the relevant entries in Table 27.2 would have to be changed to reflect a zero tax rate. We will return to this point later.

Concept Questions

27.4a What are the cash flow consequences of leasing instead of buying?

27.4b Explain why the \$10,000 in Table 27.2 has a positive sign.

27.5 Lease or Buy?

Based on our discussion thus far, Ms. Smart's analysis comes down to this: If Tasha Corp. decides to lease instead of buy, it saves **\$10,000** today because it avoids having to pay for the machine, but it must give up **\$2,395** per year for the next five years in exchange. We now must decide whether getting **\$10,000** today and then paying back **\$2,395** per year for five years is a good idea.

A PRELIMINARY ANALYSIS

Suppose Tasha were to borrow \$10,000 today and promise to make aftertax payments of \$2,395 per year for the next five years. This is essentially what Tasha will be doing if it leases instead of buying. What interest rate would Tasha be paying on this "loan"? Going back to Chapter 6, note that we need to find the unknown rate for a five-year annuity with payments of \$2,395 per year and a present value of \$10,000. It is easy to verify that the rate is 6.325 percent.

The cash flows for our hypothetical loan are identical to the cash flows from leasing instead of buying, and what we have illustrated is that when Tasha leases the machine, it effectively arranges financing at an aftertax rate of 6.325 percent. Whether this is a good deal or not depends on what rate Tasha would pay if it borrowed the money. Suppose Tasha can arrange a five-year loan with its bank at a rate of 7.1 percent. Should Tasha sign the lease or should it go with the bank?

Because Tasha is in a 21 percent tax bracket, the aftertax interest rate would be $7.1 \times (1 - .21) = 5.609$ percent. This is less than the 6.325 percent aftertax rate on the lease. In this particular case, Tasha would be better off borrowing the money because it would get a better rate.



There's an online lease-versus-buy calculator at (where else?) www.lease-vs-buy.com.

Based on this analysis, Tasha should buy rather than lease. The steps in our analysis can be summarized as follows:

1. Calculate the incremental aftertax cash flows from leasing instead of buying.
2. Use these cash flows to calculate the aftertax interest rate on the lease.
3. Compare this rate to the company's *aftertax* borrowing cost and choose the cheaper source of financing.

The most important thing to note from our discussion thus far is that in evaluating a lease, the relevant rate for the comparison is the company's *aftertax* borrowing rate. The fundamental reason is that the alternative to leasing is long-term borrowing, so the aftertax interest rate on such borrowing is the relevant benchmark.

THREE POTENTIAL PITFALLS

There are three potential problems with the interest rate that we calculated on the lease. First of all, we can interpret this rate as the internal rate of return, or IRR, on the decision to lease rather than buy; but doing so can be confusing. To see why, notice that the IRR from leasing is 6.325 percent, which is greater than Tasha's aftertax borrowing cost of 5.609 percent. Normally, the higher the IRR, the better; but we decided that leasing was a bad idea here. The reason is that the cash flows are not conventional; the first cash flow is positive and the rest are negative, which is the opposite of the conventional case (see Chapter 9 for a discussion). With this cash flow pattern, the IRR represents the rate we pay, not the rate we get—so the *lower* the IRR, the better.

A second, and related, potential pitfall has to do with the fact that we calculated the advantage of leasing instead of buying. We could have done the opposite and come up with the advantage of buying instead of leasing. If we did this, the cash flows would be the same, but the signs would be reversed. The IRR would be the same. Now, the cash flows would be conventional, so we could interpret the 6.325 percent IRR as saying that borrowing and buying is better.

The third potential problem is that our interest rate is based on the net cash flows of leasing instead of buying. There is another rate that is sometimes calculated based solely on the lease payments. If we wanted to, we could note that the lease provides \$10,000 in financing and requires five payments of \$2,500 each. It would be tempting to then determine a rate based on these numbers; but the resulting rate would not be meaningful for making lease-versus-buy decisions, and it should not be confused with the return on leasing instead of borrowing and buying.

Perhaps because of these potential sources of confusion, the IRR approach we have outlined thus far is not as widely used as the NPV-based approach that we describe next.

NPV ANALYSIS

Now that we know that the relevant rate for evaluating a lease-versus-buy decision is the firm's aftertax borrowing cost, an NPV analysis is straightforward. We discount the cash flows back to the present at Tasha's aftertax borrowing rate of 5.609 percent as follows:

$$\begin{aligned} \text{NPV} &= \$10,000 - \$2,395 \times (1 - 1/1.05609^5) / .05609 \\ &= -\$196.83 \end{aligned}$$

The NPV from leasing instead of buying is $-\$196.83$, verifying our earlier conclusion that leasing is a bad idea. Once again, notice the signs of the cash flows; the first is positive, and the rest are negative. The NPV we have computed here is often called the **net advantage to leasing (NAL)**. Surveys indicate that the NAL approach is the most popular means of lease analysis in the real world. Our nearby *Work the Web* box illustrates the use of lease-versus-buy analysis of automobiles.

net advantage to leasing (NAL)

The NPV that is calculated when deciding whether to lease an asset or to buy it.

WORK THE WEB



A major financial decision that you will likely encounter at some point is whether to buy or lease a car. We went to www.financialmentor.com to find a lease-versus-buy calculator. We analyzed a new car purchase for \$40,500 with a 48-month loan and a \$4,300 down payment. The loan rate would be 3.2 percent, and the car has a residual value of \$27,500 in four years. To lease the car for three years requires a down payment of \$4,300; the interest rate would be 3.1 percent; and the car would have a residual value of \$27,500 in three years. Both options require \$850 in fees when you take possession of the car and have a 7 percent tax rate. Based on this information, here is the lease-versus-buy analysis:

Description	(A) Lease:	(B) Buy:
14. Monthly payment:	\$346.62	\$804.47
15. Total of payments:	\$12,478.39	\$38,614.39
16. Total interest expense:		\$2,414.39
17. Net up-front expenses:	\$1,151.00	\$3,685.00
18. Depreciation expense:		\$16,000.00
19. Forgone Interest earnings:	\$0.00	\$0.00
20. Total cost:	\$13,629.39	\$22,099.39
21. Average cost per year:	\$4,543.13	\$5,524.85

According to www.financialmentor.com, leasing the car is the better financial decision because it will cost \$4,543.13 per year versus \$5,524.85.

Questions

1. Go to www.financialmentor.com and complete the same analysis, but change the term of the loan for purchasing the car to 60 months instead of the 48 months shown above. Which option is better now? Do you see a flaw in this analysis?
2. Go to the website for your favorite car manufacturer and find the price for your favorite new car. Complete the lease-versus-buy analysis for this car. Should you lease or buy your car?

A MISCONCEPTION

In our lease-versus-buy analysis, it looks as though we ignored the fact that if Tasha borrows the \$10,000 to buy the machine, it will have to repay the money with interest. In fact, we reasoned that if Tasha leased the machine, it would be better off by \$10,000 today because it wouldn't have to pay for the machine. It is tempting to argue that if Tasha borrowed the money, it wouldn't have to come up with the \$10,000. Instead, Tasha would make a series of principal and interest payments over the next five years. This observation is true, but not particularly relevant. The reason is that if Tasha borrows \$10,000 at an aftertax cost of 5.609 percent, the present value of the aftertax loan payments is \$10,000, no matter what the repayment schedule is (assuming that the loan is fully amortized). We could write down the aftertax loan repayments and work with these, but it would be extra work for no gain, assuming the lessee is currently paying taxes (see Problem 12 at the end of the chapter for an example).

Lease Evaluation

EXAMPLE 27.1

In our Tasha Corp. example, suppose Tasha is able to negotiate a lease payment of \$2,000 per year. What would be the NPV of the lease in this case?

With this new lease payment, the aftertax lease payment would be $\$2,000 \times (1 - .21) = \$1,580$, which is $\$1,975 - 1,580 = \395 less than before. Referring back to Table 27.2, note that the aftertax cash flows would be $-\$2,000$ instead of $-\$2,395$. At 5.609 percent, the NPV would be:

$$\begin{aligned} \text{NPV} &= \$10,000 - \$2,000 \times (1 - 1/1.05609^5)/.05609 \\ &= \$1,484.90 \end{aligned}$$

The lease is very attractive.

Concept Questions

- 27.5a** What is the relevant discount rate for evaluating whether or not to lease an asset? Why?
- 27.5b** Explain how to go about a lease-versus-buy analysis.

A Leasing Paradox

27.6

We previously looked at the lease-versus-buy decision from the perspective of the potential lessee, Tasha. We now turn things around and look at the lease from the perspective of the lessor, Johnson Leasing. The cash flows associated with the lease from Johnson's perspective are shown in Table 27.3. First, Johnson must buy the machine for \$10,000, so there is a **\$10,000** outflow today. Next, Johnson depreciates the machine at a rate of $\$10,000/5 = \$2,000$ per year, so the depreciation tax shield is $\$2,000 \times .21 = \420 each year. Finally, Johnson receives a lease payment of \$2,500 each year, on which it pays taxes. The aftertax lease payment received is **\$1,975**, and the total cash flow to Johnson is **\$2,395** per year.

What we see is that the cash flows to Johnson are exactly the opposite of the cash flows to Tasha. This makes perfect sense because Johnson and Tasha are the only parties to the transaction, and the lease is a zero-sum game. In other words, if the lease has a positive

TABLE 27.3

Incremental Cash Flows for Johnson Leasing

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Aftertax lease payment		+\$1,975	+\$1,975	+\$1,975	+\$1,975	+\$1,975
Depreciation tax shield		+ 420	+ 420	+ 420	+ 420	+ 420
Cost of machine	-\$10,000					
Total cash flow	-\$10,000	+\$2,395	+\$2,395	+\$2,395	+\$2,395	+\$2,395

NPV to one party, it must have a negative NPV to the other. In our case, Johnson hopes that Tasha will do the deal because the NPV for Johnson would be +\$196.83, the amount Tasha would lose.

We seem to have a paradox. In any leasing arrangement, one party must inevitably lose (or both parties exactly break even). Why, then, would leasing take place? We know that leasing is very important in the real world, so the next section describes some factors that we have omitted from our analysis thus far. These factors can make a lease attractive to both parties.

EXAMPLE 27.2

It's the Lease We Can Do

In our Tasha example, a lease payment of \$2,500 makes the lease unattractive to Tasha, and a lease payment of \$2,000 makes the lease very attractive. What payment would leave Tasha indifferent between leasing and buying?

Tasha will be indifferent when the NPV from leasing is zero. For this to happen, the present value of the cash flows from leasing instead of buying will have to be -\$10,000. From our previous efforts, we know that the lease payment must be somewhere between \$2,500 and \$2,000. To find the exact payment, we note that there are five payments and the relevant rate is 5.609 percent per year, so the cash flow from leasing instead of borrowing must be -\$2,348.77 per year.

Now that we have the cash flow from leasing instead of borrowing, we have to work backward to find the lease payment that produces this cash flow. Suppose we let LP stand for the lease payment. Referring back to Table 27.2, we see that we must have $-LP \times (1 - .21) - \$420 = -\$2,348.77$. With a little algebra, we see that the zero NPV lease payment is \$2,441.48.

Concept Questions

27.6a Why do we say that leasing is a zero-sum game?

27.6b What paradox does the previous question create?

27.7 Reasons for Leasing

Proponents of leasing make many claims about why firms should lease assets rather than buy them. Some of the reasons given to support leasing are good, and some are not. Here, we evaluate some of these reasons.

GOOD REASONS FOR LEASING

If leasing is a good choice, one or more of the following will probably be true:

1. Taxes may be reduced by leasing.
2. The lease contract may reduce certain types of uncertainty that might otherwise decrease the value of the firm.
3. Transactions costs may be lower for a lease contract than for buying the asset.
4. Leasing may require fewer (if any) restrictive covenants than secured borrowing.
5. Leasing may encumber fewer assets than secured borrowing.

Tax Advantages As we have hinted in various places, by far the most economically justifiable reason for long-term leasing is tax deferral. If the corporate income tax were repealed, long-term leasing would become much less important. The tax advantages of leasing exist because firms are in different tax positions. A potential tax shield that cannot be used as efficiently by one firm can be transferred to another by leasing.

Any tax benefits from leasing can be split between the two firms by setting the lease payments at the appropriate level, and the shareholders of both firms will benefit from this tax transfer arrangement. The loser will be the IRS. A firm in a high tax bracket will want to act as the lessor. Low tax bracket firms will be lessees, because they will not be able to use the tax advantages of ownership, such as depreciation and debt financing, as efficiently.

Recall the example from Section 27.6 and the situation of Johnson Leasing. The value of the lease it proposed to Tasha was \$369.10. However, the value of the lease to Tasha was exactly the opposite ($-\$369.10$). Because the lessor's gains came at the expense of the lessee, no mutually beneficial deal could be arranged. If Tasha paid no taxes and the lease payments were reduced to \$2,475 from \$2,500, both Johnson and Tasha would find a positive NPV in their leasing arrangement.

To see this, we can rework Table 27.2 with a zero tax rate and a \$2,475 lease payment. In this case, notice that the cash flows from leasing are the lease payments of \$2,475 because no depreciation tax shield is lost and the lease payment is not tax deductible. The cash flows from leasing are:



The biggest lessor by dollar value is www.aercap.com.

Lease versus Buy	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Lease payment		-\$2,475	-\$2,475	-\$2,475	-\$2,475	-\$2,475
Cost of machine	+\$10,000					
Total cash flow	+\$10,000	-\$2,475	-\$2,475	-\$2,475	-\$2,475	-\$2,475

Given this scenario, the value of the lease for Tasha is:

$$\begin{aligned} \text{NPV} &= \$10,000 - \$2,475 \times (1 - 1/1.0757575^5)/.0757575 \\ &= \$6.55 \end{aligned}$$

which is positive. Notice that the discount rate here is 7.57575 percent because Tasha pays no taxes; in other words, this is both the pretax and the aftertax rate.

Using Table 27.3, the value of the lease to Johnson can be worked out. With a lease payment of \$2,475, verify that the cash flows to Johnson will be \$2,375.25. The value of the lease to Johnson is:

$$\begin{aligned} \text{NPV} &= -\$10,000 + \$2,375.25 \times (1 - 1/1.05^5)/.05 \\ &= \$283.59 \end{aligned}$$

which is also positive.

As a consequence of different tax rates, the lessee (Tasha) gains \$6.55 and the lessor (Johnson) gains \$283.59. The IRS loses. What this example shows is that the lessor and the lessee can gain if their tax rates are different. The lease contract allows the lessor to take advantage of the depreciation and interest tax shields that cannot be used by the lessee. The IRS will experience a net loss of tax revenue, and some of the tax gains to the lessor can be passed on to the lessee in the form of lower lease payments.

A Reduction of Uncertainty We have noted that the lessee does not own the property when the lease expires. The value of the property at this time is called the *residual value* (or *salvage value*). When the lease contract is signed, there may be substantial uncertainty about what the residual value of the asset will be. A lease contract is a method of transferring this uncertainty from the lessee to the lessor.

Transferring the uncertainty about the residual value of an asset to the lessor makes sense when the lessor is better able to bear the risk. If the lessor is the manufacturer, then the lessor may be better able to assess and manage the risk associated with the residual value. The transfer of uncertainty to the lessor amounts to a form of insurance for the lessee. A lease therefore provides something besides long-term financing. Of course, the lessee pays for this insurance implicitly, but the lessee may view the insurance as a relative bargain.

Reduction of uncertainty is the motive for leasing most cited by corporations. For example, computers have a way of becoming technologically outdated very quickly, and computers are very commonly leased instead of purchased. In one survey, 82 percent of the responding firms cited the risk of obsolescence as an important reason for leasing, whereas only 57 percent cited the potential for cheaper financing.

Lower Transactions Costs The costs of changing ownership of an asset many times over its useful life will frequently be greater than the costs of writing a lease agreement. Consider the choice that confronts a person who lives in Los Angeles but must do business in New York for two days. Obviously, it would be cheaper to rent a hotel room for two nights than it would be to buy a condominium for two days and then sell it. Thus, lower transactions costs may be the major reason for short-term leases (operating leases). However, it is probably not the major reason for long-term leases.

Fewer Restrictions and Security Requirements As we discussed in Chapter 7, with a secured loan, the borrower will generally agree to a set of restrictive covenants, spelled out in the indenture, or loan agreement. Such restrictions are not generally found in lease agreements. Also, with a secured loan, the borrower may have to pledge other assets as security. With a lease, only the leased asset is so encumbered.

DUBIOUS REASONS FOR LEASING

Other claims provided in favor of leasing are not so good. We take a look at some of these reasons, and why they are dubious, next.

Leasing and Accounting Income Leasing can have a significant effect on the appearance of the firm's financial statements. If a firm is successful at keeping its leases off the books, the balance sheet and, potentially, the income statement can be made to look better. As a consequence, accounting-based performance measures such as return on assets, or ROA, can appear to be higher. As we have mentioned, changes in lease accounting coming in 2019 will make keeping leases off the books much more difficult.

Because an operating lease does not appear on the balance sheet under current (2017) rules, total assets (and total liabilities) will be lower with an operating lease than they

would be if the firm were to borrow the money and purchase the asset. From Chapter 3, we know that ROA is computed as net income divided by total assets. With an operating lease, net income is usually bigger and total assets are smaller, so ROA will be larger. In addition, debt covenants often do not consider operating leases as debt, which may allow a firm to obtain debtlike financing without a covenant violation.

100 Percent Financing It is often claimed that an advantage to leasing is that it provides 100 percent financing, whereas secured equipment loans require an initial down payment. Of course, a firm can borrow the down payment from another source that provides unsecured credit. Moreover, leases do usually involve a down payment in the form of an advance lease payment (or security deposit). Even when they do not involve a down payment, leases may be implicitly secured by assets of the firm other than those being leased (leasing may give the appearance of 100 percent financing, but not the substance).

Having said this, we should add that it may be the case that a firm (particularly a small one) cannot obtain debt financing because additional debt would violate a loan agreement. Operating leases frequently don't count as debt, so they may be the only source of financing available. In such cases, it isn't lease or buy—it's lease or die!

Low Cost Unscrupulous lessors can encourage lessees to base leasing decisions on the "interest rate" implied by the lease payments, which is often called the *implicit* or *effective rate*. As we discussed earlier under potential pitfalls, this rate is not meaningful in leasing decisions, and it also has no legal meaning.

OTHER REASONS FOR LEASING

There are, of course, many special reasons for some companies to find advantages in leasing. In one celebrated case, the U.S. Navy leased a fleet of tankers instead of asking Congress for appropriations. Thus, leasing may be used to circumvent capital expenditure control systems set up by bureaucratic firms. This is alleged to be a relatively common occurrence in hospitals. Likewise, many school districts lease buses and modular classrooms and pay for them out of their operating budgets when they are unable to gain approval for a bond issue to raise funds.

Concept Questions

- 27.7a** Explain why the existence of differential tax rates may be a good reason for leasing.
- 27.7b** If leasing is tax motivated, who will have the higher tax bracket, the lessee or the lessor?

Summary and Conclusions

A large fraction of America's equipment is leased rather than purchased. This chapter has described different lease types, the accounting and tax implications of leasing, and how to evaluate financial leases.

1. Leases can be separated into two types: Financial and operating. Financial leases are generally longer term, fully amortized, and not cancelable without a hefty termination payment. Operating leases are usually shorter term, partially amortized, and cancelable.

27.8

2. The distinction between financial and operating leases is important in financial accounting. Financial (capital) leases must be reported on a firm's balance sheet; operating leases are not. We discussed the specific accounting criteria for classifying leases as either capital or operating.
3. Taxes are an important consideration in leasing, and the IRS has some specific rules about what constitutes a valid lease for tax purposes.
4. A long-term financial lease is a source of financing much like long-term borrowing. We showed how to perform an NPV analysis of leasing to decide whether leasing is cheaper than borrowing. A key insight was that the appropriate discount rate is the firm's aftertax borrowing rate.
5. We saw that the existence of differential tax rates can make leasing an attractive proposition for all parties. We also mentioned that a lease decreases the uncertainty surrounding the residual value of the leased asset. This is a primary reason for leasing cited by corporations.

CONNECT TO FINANCE



Connect Finance offers you plenty of opportunities to practice mastering these concepts. Log on to connect.mheducation.com to learn more. If you like what you see, ask your professor about using *Connect Finance*!

Can you answer the following *Connect Quiz* question?

Section 27.4 Winston, Inc., is computing the net advantage to leasing for a new food processing machine. How should the estimated \$46,000 of salvage value be handled? The lease is for four years, the tax rate is 21 percent, and the aftertax discount rate is 5.2 percent.

CHAPTER REVIEW AND SELF-TEST PROBLEMS

- 27.1 Lease or Buy** Your company wants to purchase a new network file server for its wide-area computer network. The server costs \$75,000. It will be completely obsolete in three years. Your options are to borrow the money at 10 percent or to lease the machine. If you lease, the payments will be \$27,000 per year, payable at the end of each of the next three years. If you buy the server, you can depreciate it straight-line to zero over three years. The tax rate is 21 percent. Should you lease or buy?
- 27.2 NPV of Leasing** In the previous question, what is the NPV of the lease to the lessor? At what lease payment will the lessee and the lessor both break even?

ANSWERS TO CHAPTER REVIEW AND SELF-TEST PROBLEMS

- 27.1** If you buy the server, the depreciation will be \$25,000 per year. This generates a tax shield of $\$25,000 \times .21 = \$5,250$ per year, which is lost if the server is leased. The aftertax lease payment would be $\$27,000 \times (1 - .21) = \$21,330$.

Looking back at Table 27.2, you can lay out the cash flows from leasing as follows:

Lease versus Buy	Year 0	Year 1	Year 2	Year 3
Aftertax lease payment		-\$21,330	-\$21,330	-\$21,330
Lost depreciation tax shield		- 5,250	- 5,250	- 5,250
Cost of machine	+\$75,000			
Total cash flow	+\$75,000	-\$26,580	-\$26,580	-\$26,580

The appropriate discount rate is the aftertax borrowing rate of $.10 \times (1 - .21) = .079$, or 7.9 percent. The NPV of leasing instead of borrowing and buying is:

$$\begin{aligned} \text{NPV} &= \$75,000 - \$26,580 \times (1 - 1/1.079^3)/.079 \\ &= \$6,376.97 \end{aligned}$$

so leasing is cheaper.

- 27.2** Assuming that the lessor is in the same tax situation as the lessee, the NPV to the lessor is **-\$6,376.97**. In other words, the lessor loses precisely what the lessee makes.

For both parties to break even, the NPV of the lease must be **\$0**. With a 7.9 percent rate for three years, a cash flow of **-\$29,050.02** per year has a present value of **-\$75,000**. The lost depreciation tax shield is still **-\$5,250**, so the aftertax lease payment must be **\$23,800.02**. The lease payment that produces a zero NPV is therefore $\$23,800.02/.79 = \$30,126.60$ per year.

CONCEPTS REVIEW AND CRITICAL THINKING QUESTIONS

1. **Leasing versus Borrowing [LO2]** What are the key differences between leasing and borrowing? Are they perfect substitutes?
2. **Leasing and Taxes [LO3]** Taxes are an important consideration in the leasing decision. Who is more likely to lease, a profitable corporation in a high tax bracket or a less profitable one in a low tax bracket? Why?
3. **Leasing and IRR [LO3]** What are some of the potential problems with looking at IRRs in evaluating a leasing decision?
4. **Leasing [LO2]** Comment on the following remarks:
 - a. Leasing reduces risk and can reduce a firm's cost of capital.
 - b. Leasing provides 100 percent financing.
 - c. If the tax advantages of leasing were eliminated, leasing would disappear.
5. **Accounting for Leases [LO1]** Discuss the accounting criteria for determining whether or not a lease must be reported on the balance sheet using the accounting rules in place before 2019. In each case, give a rationale for the criterion.
6. **IRS Criteria [LO1]** Discuss the IRS criteria for determining whether or not a lease is tax deductible. In each case, give a rationale for the criterion.
7. **Off-Balance-Sheet Financing [LO1]** What is meant by the term *off-balance-sheet financing*? When do leases provide such financing, and what are the accounting and economic consequences of such activity?
8. **Sale and Leaseback [LO1]** Why might a firm choose to engage in a sale and leaseback transaction? Give two reasons.
9. **Leasing Cost [LO3]** Explain why the aftertax borrowing rate is the appropriate discount rate to use in lease evaluation.

Refer to the following example for Questions 10 through 12:

In February 2017, Air Lease Corporation (ALC) announced a deal to lease five new Boeing 787-9 passenger aircraft to China Southern Airlines. ALC had the aircraft on purchase order from Boeing and planned to deliver three of the planes to China Southern in 2019 and the other two planes in 2020.

- 10. Lease versus Purchase [LO2]** Why wouldn't China Southern purchase the planes if they were obviously needed for the company's operations?

11. **Reasons to Lease [LO2]** Why would ALC be willing to buy planes from Boeing and then lease them to China Southern? How is this different from lending money to China Southern to buy planes?
12. **Leasing [LO2]** What do you suppose happens to the planes at the end of the lease period?

QUESTIONS AND PROBLEMS



(Questions 1–6)

Use the following information to work Problems 1 through 6:

You work for a nuclear research laboratory that is contemplating leasing a diagnostic scanner (leasing is a very common practice with expensive, high-tech equipment). The scanner costs \$4,800,000, and it would be depreciated straight-line to zero over four years. Because of radiation contamination, it actually will be completely valueless in four years. You can lease it for \$1,430,000 per year for four years.

- ☒ 1. **Lease or Buy [LO3]** Assume that the tax rate is 21 percent. You can borrow at 8 percent before taxes. Should you lease or buy?
- ☒ 2. **Leasing Cash Flows [LO3]** What is the NAL of the lease from the lessor's viewpoint? Assume a 21 percent tax rate.
- ☒ 3. **Finding the Break-Even Payment [LO3]** What would the lease payment have to be for both lessor and lessee to be indifferent about the lease?
- ☒ 4. **Taxes and Leasing Cash Flows [LO3]** Assume that your company does not anticipate paying taxes for the next several years. What are the cash flows from leasing in this case?
- ☒ 5. **Setting the Lease Payment [LO3]** In Problem 4, over what range of lease payments will the lease be profitable for both parties?
- ☒ 6. **MACRS Depreciation and Leasing [LO3]** Rework Problem 1 assuming that the scanner will be depreciated as three-year property under MACRS (see Chapter 10 for the depreciation allowances).

Use the following information to work Problems 7 through 9:

INTERMEDIATE

(Questions 7–11)

The Wildcat Oil Company is trying to decide whether to lease or buy a new computer-assisted drilling system for its oil exploration business. Management has decided that it must use the system to stay competitive; it will provide \$2.3 million in annual pretax cost savings. The system costs \$7.3 million and will be depreciated straight-line to zero over five years. Wildcat's tax rate is 21 percent, and the firm can borrow at 7 percent. Lambert Leasing Company has offered to lease the drilling equipment to Wildcat for payments of \$1.625 million per year. Lambert's policy is to require its lessees to make payments at the start of the year.

- ☒ 7. **Lease or Buy [LO3]** What is the NAL for Wildcat? What is the maximum lease payment that would be acceptable to the company?
- ☒ 8. **Leasing and Salvage Value [LO3]** Suppose it is estimated that the equipment will have an aftertax residual value of \$900,000 at the end of the lease. What is the maximum lease payment acceptable to Wildcat now?
- ☒ 9. **Deposits in Leasing [LO3]** Many lessors require a security deposit in the form of a cash payment or other pledged collateral. Suppose Lambert requires Wildcat to pay a \$600,000 security deposit at the inception of the lease. If the lease payment is still \$1.625 million, is it advantageous for Wildcat to lease the equipment now?
- ☒ 10. **Setting the Lease Price [LO3]** An asset costs \$630,000 and will be depreciated in a straight-line manner over its three-year life. It will have no salvage value. The lessor

can borrow at 6 percent and the lessee can borrow at 9 percent. The corporate tax rate is 21 percent for both companies.

- a. How does the fact that the lessor and lessee have different borrowing rates affect the calculation of the NAL?
- b. What set of lease payments will make the lessee and the lessor equally well off?
- c. Assume that the lessee pays no taxes and the lessor is in the 21 percent tax bracket. For what range of lease payments does the lease have a positive NPV for both parties?

- 11. Automobile Lease Payments [LO3]** Automobiles are often leased, and several terms are unique to auto leases. Suppose you are considering leasing a car. The price you and the dealer agree on for the car is \$41,900. This is the base capitalized cost. Other costs added to the capitalized cost price include the acquisition (bank) fee, insurance, or extended warranty. Assume these costs are \$850. Capitalization cost reductions include any down payment, credit for trade-in, or dealer rebate. Assume you make a down payment of \$4,300, and there is no trade-in or rebate. If you drive 10,000 miles per year, the lease-end residual value for this car will be \$30,500 after three years. The lease or “money” factor, which is the interest rate on the loan, is the APR of the loan divided by 2,400.⁶ The lease factor the dealer quotes you is .00195. The monthly lease payment consists of three parts: A depreciation fee, a finance fee, and sales tax. The depreciation fee is the net capitalization cost minus the residual value, divided by the term of the lease. The net capitalization cost is the cost of the car minus any cost reductions plus any additional costs. The finance fee is the net capitalization cost plus the residual, times the money factor, and the monthly sales tax is the depreciation payment plus the finance fee, times the tax rate. What APR is the dealer quoting you? What is your monthly lease payment for a 36-month lease if the sales tax is 7 percent?
- 12. Lease versus Borrow [LO3]** Return to the case of the diagnostic scanner used in Problems 1 through 6. Suppose the entire \$4,800,000 purchase price of the scanner is borrowed. The rate on the loan is 8 percent, and the loan will be repaid in equal installments. Create a lease-versus-buy analysis that explicitly incorporates the loan payments. Show that the NPV of leasing instead of buying is not changed from what it was in Problem 1. Why is this so?

CHALLENGE

(Question 12)

⁶The money factor of 2,400 is the product of three numbers: 2, 12, and 100. The 100 is used to convert the APR, expressed as a percentage, to a decimal number. The 12 converts this rate to a monthly rate. Finally, the monthly rate is applied to the sum of the net capitalization cost plus the residual. If we divide this sum by 2, the result is the average anticipated book value. Thus, the end result of the calculation using the money factor is to multiply a monthly rate by the average book value to get a monthly payment.

MINICASE

The Decision to Lease or Buy at Warf Computers

Warf Computers has decided to proceed with the manufacture and distribution of the virtual keyboard (VK) the company has developed. To undertake this venture, the company needs to obtain equipment for the production of the microphone for the keyboard. Because of the required sensitivity of the microphone and its small size, the company needs specialized equipment for production.

Nick Warf, the company president, has found a vendor for the equipment. Clapton Acoustical Equipment has offered to sell Warf Computers the necessary equipment at a price of \$6.1 million. Because of the rapid development of new technology, the equipment falls in the three-year MACRS depreciation class. At the end of four years, the market value of the equipment is expected to be \$780,000.

Alternatively, the company can lease the equipment from Hendrix Leasing. The lease contract calls for four annual payments of \$1.48 million due at the beginning of the year. Additionally, Warf Computers must make a security deposit of \$400,000 that will be returned when the lease expires. Warf Computers can issue bonds with a yield of 11 percent, and the company has a marginal tax rate of 21 percent.

QUESTIONS

1. Should Warf buy or lease the equipment?
2. Nick mentions to James Hendrix, the president of Hendrix Leasing, that although the company will need the equipment for four years, he would like a lease contract for two years instead. At the end of the two years, the lease could be renewed. Nick would also like to eliminate the security deposit, but he would be willing to increase the lease payments to \$1.775 million for each of the two years. When the lease is renewed in two years, Hendrix would consider the increased lease payments in the first two years when calculating the terms of the renewal. The equipment is expected to have a market value of \$3.2 million in two years. What is the NAL of the lease

contract under these terms? Why might Nick prefer this lease? What are the potential ethical issues concerning the new lease terms?

3. In the leasing discussion, James informs Nick that the contract could include a purchase option for the equipment at the end of the lease. Hendrix Leasing offers three purchase options:
 - a. An option to purchase the equipment at the fair market value.
 - b. An option to purchase the equipment at a fixed price. The price will be negotiated before the lease is signed.
 - c. An option to purchase the equipment at a price of \$250,000.

How would the inclusion of a purchase option affect the value of the lease?

4. James also informs Nick that the lease contract can include a cancellation option. The cancellation option would allow Warf Computers to cancel the lease on any anniversary date of the contract. To cancel the lease, Warf Computers would be required to give 30 days' notice prior to the anniversary date. How would the inclusion of a cancellation option affect the value of the lease?

A

MATHEMATICAL TABLES

TABLE A.1

Future value of \$1 at the end of t periods = $(1 + r)^t$

TABLE A.2

Present value of \$1 to be received after t periods = $1/(1 + r)^t$

TABLE A.3

Present value of an annuity of \$1 per period for t periods = $[1 - 1/(1 + r)^t]/r$

TABLE A.4

Future value of an annuity of \$1 per period for t periods = $[(1 + r)^t - 1]/r$

TABLE A.5

Cumulative normal distribution

TABLE A.1 Future value of \$1 at the end of t periods = $(1 + r)^t$

Period	Interest Rate								
	1%	2%	3%	4%	5%	6%	7%	8%	9%
1	1.0100	1.0200	1.0300	1.0400	1.0500	1.0600	1.0700	1.0800	1.0900
2	1.0201	1.0404	1.0609	1.0816	1.1025	1.1236	1.1449	1.1664	1.1881
3	1.0303	1.0612	1.0927	1.1249	1.1576	1.1910	1.2250	1.2597	1.2950
4	1.0406	1.0824	1.1255	1.1699	1.2155	1.2625	1.3108	1.3605	1.4116
5	1.0510	1.1041	1.1593	1.2167	1.2763	1.3382	1.4026	1.4693	1.5386
6	1.0615	1.1262	1.1941	1.2653	1.3401	1.4185	1.5007	1.5869	1.6771
7	1.0721	1.1487	1.2299	1.3159	1.4071	1.5036	1.6058	1.7138	1.8280
8	1.0829	1.1717	1.2668	1.3686	1.4775	1.5938	1.7182	1.8509	1.9926
9	1.0937	1.1951	1.3048	1.4233	1.5513	1.6895	1.8385	1.9990	2.1719
10	1.1046	1.2190	1.3439	1.4802	1.6289	1.7908	1.9672	2.1589	2.3674
11	1.1157	1.2434	1.3842	1.5395	1.7103	1.8983	2.1049	2.3316	2.5804
12	1.1268	1.2682	1.4258	1.6010	1.7959	2.0122	2.2522	2.5182	2.8127
13	1.1381	1.2936	1.4685	1.6651	1.8856	2.1329	2.4098	2.7196	3.0658
14	1.1495	1.3195	1.5126	1.7317	1.9799	2.2609	2.5785	2.9372	3.3417
15	1.1610	1.3459	1.5580	1.8009	2.0789	2.3966	2.7590	3.1722	3.6425
16	1.1726	1.3728	1.6047	1.8730	2.1829	2.5404	2.9522	3.4259	3.9703
17	1.1843	1.4002	1.6528	1.9479	2.2920	2.6928	3.1588	3.7000	4.3276
18	1.1961	1.4282	1.7024	2.0258	2.4066	2.8543	3.3799	3.9960	4.7171
19	1.2081	1.4568	1.7535	2.1068	2.5270	3.0256	3.6165	4.3157	5.1417
20	1.2202	1.4859	1.8061	2.1911	2.6533	3.2071	3.8697	4.6610	5.6044
21	1.2324	1.5157	1.8603	2.2788	2.7860	3.3996	4.1406	5.0338	6.1088
22	1.2447	1.5460	1.9161	2.3699	2.9253	3.6035	4.4304	5.4365	6.6586
23	1.2572	1.5769	1.9736	2.4647	3.0715	3.8197	4.7405	5.8715	7.2579
24	1.2697	1.6084	2.0328	2.5633	3.2251	4.0489	5.0724	6.3412	7.9111
25	1.2824	1.6406	2.0938	2.6658	3.3864	4.2919	5.4274	6.8485	8.6231
30	1.3478	1.8114	2.4273	3.2434	4.3219	5.7435	7.6123	10.063	13.268
40	1.4889	2.2080	3.2620	4.8010	7.0400	10.286	14.974	21.725	31.409
50	1.6446	2.6916	4.3839	7.1067	11.467	18.420	29.457	46.902	74.358
60	1.8167	3.2810	5.8916	10.520	18.679	32.988	57.946	101.26	176.03

continued on next page

10%	12%	14%	15%	16%	18%	20%	24%	28%	32%	36%
1.1000	1.1200	1.1400	1.1500	1.1600	1.1800	1.2000	1.2400	1.2800	1.3200	1.3600
1.2100	1.2544	1.2996	1.3225	1.3456	1.3924	1.4400	1.5376	1.6384	1.7424	1.8496
1.3310	1.4049	1.4815	1.5209	1.5609	1.6430	1.7280	1.9066	2.0972	2.3000	2.5155
1.4641	1.5735	1.6890	1.7490	1.8106	1.9388	2.0736	2.3642	2.6844	3.0360	3.4210
1.6105	1.7623	1.9254	2.0114	2.1003	2.2878	2.4883	2.9316	3.4360	4.0075	4.6526
1.7716	1.9738	2.1950	2.3131	2.4364	2.6996	2.9860	3.6352	4.3980	5.2899	6.3275
1.9487	2.2107	2.5023	2.6600	2.8262	3.1855	3.5832	4.5077	5.6295	6.9826	8.6054
2.1436	2.4760	2.8526	3.0590	3.2784	3.7589	4.2998	5.5895	7.2058	9.2170	11.703
2.3579	2.7731	3.2519	3.5179	3.8030	4.4355	5.1598	6.9310	9.2234	12.166	15.917
2.5937	3.1058	3.7072	4.0456	4.4114	5.2338	6.1917	8.5944	11.806	16.060	21.647
2.8531	3.4785	4.2262	4.6524	5.1173	6.1759	7.4301	10.657	15.112	21.199	29.439
3.1384	3.8960	4.8179	5.3503	5.9360	7.2876	8.9161	13.215	19.343	27.983	40.037
3.4523	4.3635	5.4924	6.1528	6.8858	8.5994	10.699	16.386	24.759	36.937	54.451
3.7975	4.8871	6.2613	7.0757	7.9875	10.147	12.839	20.319	31.691	48.757	74.053
4.1772	5.4736	7.1379	8.1371	9.2655	11.974	15.407	25.196	40.565	64.359	100.71
4.5950	6.1304	8.1372	9.3576	10.748	14.129	18.488	31.243	51.923	84.954	136.97
5.0545	6.8660	9.2765	10.761	12.468	16.672	22.186	38.741	66.461	112.14	186.28
5.5599	7.6900	10.575	12.375	14.463	19.673	26.623	48.039	85.071	148.02	253.34
6.1159	8.6128	12.056	14.232	16.777	23.214	31.948	59.568	108.89	195.39	344.54
6.7275	9.6463	13.743	16.367	19.461	27.393	38.338	73.864	139.38	257.92	468.57
7.4002	10.804	15.668	18.822	22.574	32.324	46.005	91.592	178.41	340.45	637.26
8.1403	12.100	17.861	21.645	26.186	38.142	55.206	113.57	228.36	449.39	866.67
8.9543	13.552	20.362	24.891	30.376	45.008	66.247	140.83	292.30	593.20	1178.7
9.8497	15.179	23.212	28.625	35.236	53.109	79.497	174.63	374.14	783.02	1603.0
10.835	17.000	26.462	32.919	40.874	62.669	95.396	216.54	478.90	1033.6	2180.1
17.449	29.960	50.950	66.212	85.850	143.37	237.38	634.82	1645.5	4142.1	10143.0
45.259	93.051	188.88	267.86	378.72	750.38	1469.8	5455.9	19426.7	66520.8	*
117.39	289.00	700.23	1083.7	1670.7	3927.4	9100.4	46890.4	*	*	*
304.48	897.60	2595.9	4384.0	7370.2	20555.1	56347.5	*	*	*	*

*The factor is greater than 99,999.

TABLE A.2 Present value of \$1 to be received after t periods = $1/(1 + r)^t$

Period	Interest Rate								
	1%	2%	3%	4%	5%	6%	7%	8%	9%
1	.9901	.9804	.9709	.9615	.9524	.9434	.9346	.9259	.9174
2	.9803	.9612	.9426	.9246	.9070	.8900	.8734	.8573	.8417
3	.9706	.9423	.9151	.8890	.8638	.8396	.8163	.7938	.7722
4	.9610	.9238	.8885	.8548	.8227	.7921	.7629	.7350	.7084
5	.9515	.9057	.8626	.8219	.7835	.7473	.7130	.6806	.6499
6	.9420	.8880	.8375	.7903	.7462	.7050	.6663	.6302	.5963
7	.9327	.8706	.8131	.7599	.7107	.6651	.6227	.5835	.5470
8	.9235	.8535	.7894	.7307	.6768	.6274	.5820	.5403	.5019
9	.9143	.8368	.7664	.7026	.6446	.5919	.5439	.5002	.4604
10	.9053	.8203	.7441	.6756	.6139	.5584	.5083	.4632	.4224
11	.8963	.8043	.7224	.6496	.5847	.5268	.4751	.4289	.3875
12	.8874	.7885	.7014	.6246	.5568	.4970	.4440	.3971	.3555
13	.8787	.7730	.6810	.6006	.5303	.4688	.4150	.3677	.3262
14	.8700	.7579	.6611	.5775	.5051	.4423	.3878	.3405	.2992
15	.8613	.7430	.6419	.5553	.4810	.4173	.3624	.3152	.2745
16	.8528	.7284	.6232	.5339	.4581	.3936	.3387	.2919	.2519
17	.8444	.7142	.6050	.5134	.4363	.3714	.3166	.2703	.2311
18	.8360	.7002	.5874	.4936	.4155	.3503	.2959	.2502	.2120
19	.8277	.6864	.5703	.4746	.3957	.3305	.2765	.2317	.1945
20	.8195	.6730	.5537	.4564	.3769	.3118	.2584	.2145	.1784
21	.8114	.6598	.5375	.4388	.3589	.2942	.2415	.1987	.1637
22	.8034	.6468	.5219	.4220	.3418	.2775	.2257	.1839	.1502
23	.7954	.6342	.5067	.4057	.3256	.2618	.2109	.1703	.1378
24	.7876	.6217	.4919	.3901	.3101	.2470	.1971	.1577	.1264
25	.7798	.6095	.4776	.3751	.2953	.2330	.1842	.1460	.1160
30	.7419	.5521	.4120	.3083	.2314	.1741	.1314	.0994	.0754
40	.6717	.4529	.3066	.2083	.1420	.0972	.0668	.0460	.0318
50	.6080	.3715	.2281	.1407	.0872	.0543	.0339	.0213	.0134

continued on next page

10%	12%	14%	15%	16%	18%	20%	24%	28%	32%	36%
.9091	.8929	.8772	.8696	.8621	.8475	.8333	.8065	.7813	.7576	.7353
.8264	.7972	.7695	.7561	.7432	.7182	.6944	.6504	.6104	.5739	.5407
.7513	.7118	.6750	.6575	.6407	.6086	.5787	.5245	.4768	.4348	.3975
.6830	.6355	.5921	.5718	.5523	.5158	.4823	.4230	.3725	.3294	.2923
.6209	.5674	.5194	.4972	.4761	.4371	.4019	.3411	.2910	.2495	.2149
.5645	.5066	.4556	.4323	.4104	.3704	.3349	.2751	.2274	.1890	.1580
.5132	.4523	.3996	.3759	.3538	.3139	.2791	.2218	.1776	.1432	.1162
.4665	.4039	.3506	.3269	.3050	.2660	.2326	.1789	.1388	.1085	.0854
.4241	.3606	.3075	.2843	.2630	.2255	.1938	.1443	.1084	.0822	.0628
.3855	.3220	.2697	.2472	.2267	.1911	.1615	.1164	.0847	.0623	.0462
.3505	.2875	.2366	.2149	.1954	.1619	.1346	.0938	.0662	.0472	.0340
.3186	.2567	.2076	.1869	.1685	.1372	.1122	.0757	.0517	.0357	.0250
.2897	.2292	.1821	.1625	.1452	.1163	.0935	.0610	.0404	.0271	.0184
.2633	.2046	.1597	.1413	.1252	.0985	.0779	.0492	.0316	.0205	.0135
.2394	.1827	.1401	.1229	.1079	.0835	.0649	.0397	.0247	.0155	.0099
.2176	.1631	.1229	.1069	.0930	.0708	.0541	.0320	.0193	.0118	.0073
.1978	.1456	.1078	.0929	.0802	.0600	.0451	.0258	.0150	.0089	.0054
.1799	.1300	.0946	.0808	.0691	.0508	.0376	.0208	.0118	.0068	.0039
.1635	.1161	.0829	.0703	.0596	.0431	.0313	.0168	.0092	.0051	.0029
.1486	.1037	.0728	.0611	.0514	.0365	.0261	.0135	.0072	.0039	.0021
.1351	.0926	.0638	.0531	.0443	.0309	.0217	.0109	.0056	.0029	.0016
.1228	.0826	.0560	.0462	.0382	.0262	.0181	.0088	.0044	.0022	.0012
.1117	.0738	.0491	.0402	.0329	.0222	.0151	.0071	.0034	.0017	.0008
.1015	.0659	.0431	.0349	.0284	.0188	.0126	.0057	.0027	.0013	.0006
.0923	.0588	.0378	.0304	.0245	.0160	.0105	.0046	.0021	.0010	.0005
.0573	.0334	.0196	.0151	.0116	.0070	.0042	.0016	.0006	.0002	.0001
.0221	.0107	.0053	.0037	.0026	.0013	.0007	.0002	.0001	*	*
.0085	.0035	.0014	.0009	.0006	.0003	.0001	*	*	*	*

*The factor is zero to four decimal places.