14-1 Book, Market, or "Target" Weights?

Capital
Investor-supplied funds such as long- and short-term loans from individuals and institutions, preferred stock, common stock, and retained earnings.

Capital Structure
The mix of debt, preferred stock, and common equity that is used to finance the firm's assets.

Optimal Capital Structure
The capital structure that maximizes a stock's intrinsic value.

The term **capital** refers to *investor-supplied funds*—debt, preferred stock, common stock, and retained earnings.[1] Accounts payable and accruals are *not* included in our definition of capital because they are not provided by investors—they come from suppliers, workers, and taxing authorities as a result of normal operations, not as investments by investors. A firm's **capital structure** is typically defined as the percentage of each type of investor-supplied capital, with the total being 100%. The **optimal capital structure** is the mix of debt, preferred stock, and common equity that maximizes the stock's intrinsic value. As we will see, the capital structure that maximizes the intrinsic value also minimizes the WACC.

14-1a Measuring the Capital Structure

To begin, we must answer this question: How should the capital structure be measured? Should we work with book values as provided by accountants and shown on the balance sheet; with the market values of the debt, preferred stock, and common equity; or with some other set of numbers? To see what's involved, consider Table 14.1, which compares the book and market values for Caterpillar (CAT) from a recent financial statement.[2]

Maslow's Book value vs market value

TABLE 14.1 "Snapshot" of 12/31/13 Caterpillar Inc.'s Book Value, Market Value, and Target Capital Structure (Billions of Dollars)

Condensed Balance Sheet Assets and Claims Against Assets at Book Values					Investor-supplied capital: Payables and accruals are excluded because they come from operations, not from investors				
	Assets		Claims		Book Value		Market Value		Target %
Cash	$ 6.1	Accounts payable	$ 7.0	8.2%	–	–	–	–	–
Receivables	17.2	Accruals	9.3	11.0%	–	–	–	–	–
Inventories	12.6								
Other C.A.	2.4	Notes payable (ST debt)	11.0	13.0%	$11.0	16%	$ 11.0	10%	5%
Total C.A.	$38.3	Total C.L.	$27.3	32.2%					
		Long-term debt	36.7	43.2%	36.7	53%	36.7	35%	45%
Fixed assets	$46.6	Total liabilities	$64.0	75.4%	$47.7	**70%**	$ 47.7	**45%**	**50%**
		Common stock	$4.7	5.5%	$4.7				
		Retained earnings	16.2	19.1%	16.2				
		Total common equity	$20.9	24.6%	$20.9	**30%**	$ 57.9	**55%**	**50%**
Total assets	$84.9	Total claims	$84.9	100%	$68.6	100%	$105.6	100%	100%

Note: At the time of this analysis, CAT had 637.8 million shares outstanding; its book value per share was $32.73; and its market price was $90.81 per share. *We do not know its management-determined target capital structure. The 50% debt ratio is just our estimate of what a reasonable target might be.* The procedure illustrated in Section 14-3 shows how CAT *might* go about establishing its target capital structure.

[1] Capital is frequently defined to include only long-term debt, that is, debt due in more than a year. However, many companies use short-term loans from banks on a permanent basis, and for this reason we include short-term debt that is *provided by investors* in our definition of "capital."

[2] CAT's actual balance sheet is broken down into so many elements that it is several pages long. For convenience, we compress it into the categories shown in Table 14.1. The data used in the table are from its December 31, 2013, balance sheet.

1. In this case, as is generally true, the market value of the debt was fairly close to its book value; so, for simplicity, we show the same dollars of debt in both the book and market columns.
2. However at the time of this analysis, the common stock sold for $90.81 per share versus its $32.73 book value. There were 637.8 million shares outstanding, so the market value of the equity was $57.9 billion, calculated as $90.81(637,800,000) = $57.9 billion, versus a $20.9 billion book value.
3. For capital structure purposes, no distinction is made between common equity raised by issuing stock versus retaining earnings. Stockholders provided both components, either by purchasing newly issued shares or by allowing management to retain earnings rather than to distribute them as dividends.
4. Caterpillar does not use preferred stock, but if it did, the market value of preferred would be calculated in the same way as we calculated the market value of its common equity.
5. According to most financial theorists, it is better to use market values than book values. However, most financial analysts report data on a book-value basis, and bond rating agencies report book values and seem to give them at least as much weight as market values. Also, stock prices are quite volatile; so, if we use market values, then the weights used to calculate the WACC will also be volatile. For all these reasons, some analysts argue for the use of book values.
6. In a perfect world, a firm would identify its optimal capital structure based on market values, raise capital so as to maintain that structure, and use the optimal percentages to calculate its WACC. However, the world is not perfect. It is impossible to identify a precisely optimal structure, and given the volatility inherent in financial markets, it would be impossible to remain on target over time even if the optimal structure could be identified. As a result, most firms focus on a *target debt ratio range* as opposed to a single number.[3]
7. Generally, a firm's CFO considers the capital structures of the firms against which it benchmarks and performs an analysis similar to what we do in the remainder of this chapter.
8. Assume that Caterpillar's management concluded that the firm's optimal capital structure has 50% debt and set its target debt range at 45% to 55%. The equity range is thus (1 − % Debt), or between 45% and 55% equity. Now, for simplicity, assume that the average interest rate on both short-term and long-term debt is 5%; the cost of equity is 11%; and its corporate tax rate is approximately 30%. Using weights from Table 14.1, the following calculations show that the choice of capital structure makes a significant difference in the WACC estimates:

$$\begin{aligned}
WACC_{Book} &= w_{d(Book)}(r_d)(1-T) + w_{c(Book)}(r_s) \\
&= 0.70(5\%)(1-0.3) + 0.30(11\%) = 0.0245 + 0.0330 = 5.75\% \\
WACC_{Market} &= w_{d(Market)}(r_d)(1-T) + w_{c(Market)}(r_s) \\
&= 0.45(5\%)(1-0.3) + 0.55(11\%) = 0.0158 + 0.0605 = 7.63\% \\
WACC_{Target} &= w_{d(Target)}(r_d)(1-T) + w_{c(Target)}(r_s) \\
&= 0.5(5\%)(1-0.3) + 0.5(11\%) = 0.0175 + 0.055 = 7.25\%
\end{aligned}$$

The greater the difference between the stock's book value and market value, the greater the difference between the alternative WACCs.

[3]A study by Graham and Harvey surveyed corporate managers and asked whether their firms established a target capital structure. Eighty-one percent of the respondents indicated that their firms did have target capital structures. Ten percent said that they had strict target debt ratios; 34% indicated that they had a somewhat tight range for their target debt ratios; and 37% indicated that they had flexible targets. See John R. Graham and Campbell R. Harvey, "The Theory and Practice of Corporate Finance: Evidence from the Field," *Journal of Financial Economics*, vol. 60, nos. 2 & 3 (May–June 2001), pp. 187–243.

9. Using the 50% midpoint target debt ratio, our estimate of CAT's WACC for an average-risk project would be 7.25%, or approximately 7.3%.

If the actual debt ratio were significantly below the target range, the firm would probably raise capital by issuing debt, whereas if the debt ratio were above the target range, equity would probably be used. Note also that the target range is likely to change over time as conditions change. As discussed in the opening vignette, Caterpillar has initiated a stock buy-back program, so it appears that the company's target debt ratio is somewhere in the higher part of the 45%–55% range.

14-1B Capital Structure Changes over Time

Firms' actual capital structures change over time, and for two quite different reasons:

- *Deliberate actions:* If a firm is not currently at its target, it may deliberately raise new money in a manner that moves the actual structure toward the target.
- *Market actions:* The firm could incur high profits or losses that lead to significant changes in book value equity as shown on its balance sheet and to a decline in its stock price. Similarly, although the book value of its debt would probably not change, interest rate changes due to changes in the general level of rates and/or changes in the firm's default risk could cause significant changes in its debt's market value. Such changes in the market value of the debt and/or equity could result in large changes in its measured capital structure.

Still, at any given moment, most firms have a specific target range in mind.[4] If the actual debt ratio has surpassed the target, a firm can sell a large stock issue and use the proceeds to retire debt. Or, if the stock price has increased and pushed the debt ratio below the target, it can issue bonds and use the proceeds to repurchase stock. And, of course, a firm can gradually move toward its target through its annual financings to support its capital budget.[5]

SELF TEST

Define the terms "book-value capital structure," "market-value capital structure," and "target capital structure," and explain why they differ from one another.

Would the market-value debt ratio tend to be higher than the book-value debt ratio during a stock market boom or a recession? Explain.

Why would the WACC based on market values tend to be higher than the one based on book values if the stock price exceeded its book value?

Which would you expect to be more stable over time, a firm's book-value or market-value capital structure? Explain.

[4]Even if the firm concluded that its debt ratio was below the lower limit—then it could finance its entire capital budget for the year with debt—it should still use a WACC based on the target capital structure when evaluating projects for inclusion in the firm's capital budget.

[5]Firms face costs when they adjust their capital structure, and this is particularly the case if the firm has to pay an investment banker to help it raise new debt or equity. Consequently, if the benefits of moving toward their target capital structure (a lower WACC) are less than the costs of adjusting their capital structure, firms may decide not to immediately adjust their capital structure to its target level. If you are interested in more details about capital structure adjustments, see the following article, which looks at the connection between transactions costs and the speed at which firms adjust to their target capital structure: Michael W. Faulkender, Mark J. Flannery, Kristine Watson Hankins, and Jason M. Smith, "Cash Flows and Leverage Adjustments," *Journal of Financial Economics*, vol. 103, no. 3 (March 2012), pp. 632–646.

14-2 Business and Financial Risk

In Chapter 8, we examined risk from the viewpoint of an individual investor and we distinguished between *risk on a stand-alone basis*, where an asset's cash flows are analyzed by themselves, and *risk in a portfolio context*, where cash flows from a number of assets are combined and consolidated cash flows are analyzed. In a portfolio context, we saw that an asset's risk can be divided into two components: *diversifiable risk*, which can be diversified away and hence is of little concern to most investors, and *market risk*, which is measured by the beta coefficient and reflects broad market movements that cannot be eliminated by diversification and therefore is of concern to investors. Then in Chapter 12, we examined risk from the viewpoint of the corporation, and we considered how capital budgeting decisions affect the firm's riskiness.

Now we introduce two new dimensions of risk:

1. *Business risk*, which is the riskiness of the firm's assets if no debt is used.
2. *Financial risk*, which is the additional risk placed on the common stockholders as a result of using debt.

14-2a Business Risk

Business risk is the single most important determinant of capital structure, and it represents the amount of risk that is inherent in the firm's operations even if it uses no debt financing. A commonly used measure of business risk is the standard deviation of the firm's return on invested capital, or ROIC. Recall from Chapter 4 that ROIC is defined as follows:[6]

Business Risk
The riskiness inherent in the firm's operations if it uses no debt.

$$\text{ROIC} = \text{EBIT}(1 - \text{T})/\text{Total invested capital}$$

ROIC measures the after-tax return that the company provides for all of its investors. Because ROIC does not vary with changes in capital structure, the standard deviation of ROIC (σ_{ROIC}) measures the underlying risk of the firm before considering the effects of debt financing, thereby providing a good measure of business risk.[7]

We use Bigbee Electronics, a *debt-free (unlevered)* firm, to illustrate business risk. The top graph in Figure 14.1 shows the trend in Bigbee's return on invested capital, or ROIC, from 2006 through 2014. Graphs like this show security analysts and managers how much ROIC has varied in the past and thus might vary in the future. The lower graph shows the probability distribution of Bigbee's ROIC, based on the 2006–2014 data given in the top section.

Bigbee's ROIC fluctuations were caused by many factors—booms and recessions in the economy, successful new products introduced by Bigbee and its competitors, labor strikes, a fire in Bigbee's main plant, and so on. Similar events will doubtless occur in the future, and when they do, the realized ROIC will be higher or lower than the expected 9.0%. Further, there is always the possibility that a long-term disaster will strike, permanently depressing the company's earning power. For example, a competitor might introduce a new product that makes Bigbee's products totally obsolete and puts the company out of business—much like what happened to buggy manufacturers when automobiles were invented.

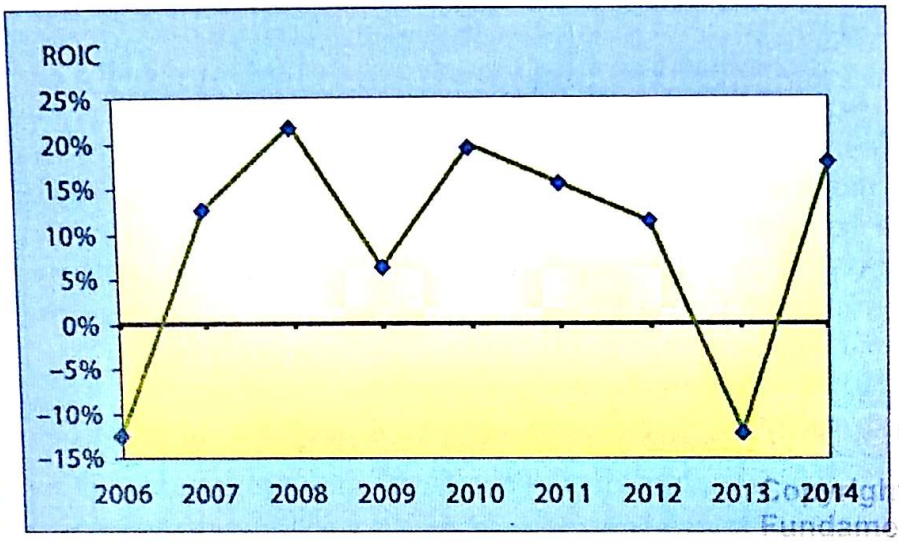
[6]Also note that EBIT(1 – T) is the after-tax income the firm would have if it used no debt. Similarly, ROIC is the ROE the firm would have if it were debt-free.

[7]At the outset, we assume that changes in capital structure have no effect on the firm's operating performance. Later in the chapter, we discuss some circumstances when the level of debt financing may affect the company's operating performance (EBIT); in these circumstances, ROIC would vary

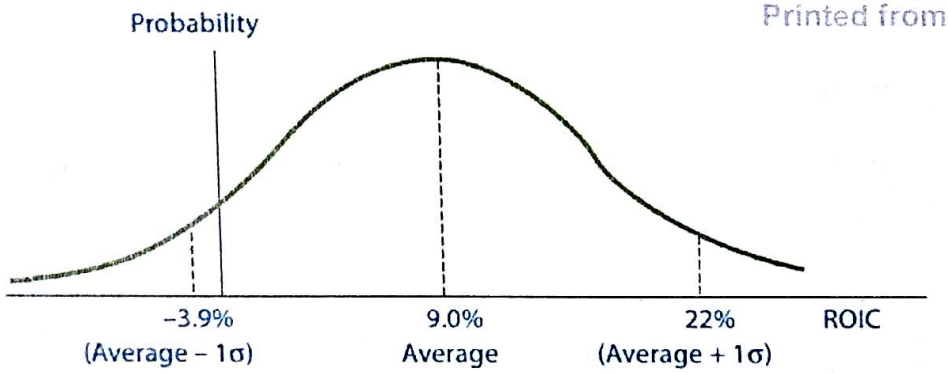
FIGURE 14.1 Return on Invested Capital (ROIC), 2006–2014

a. ROIC Over Time: An Indicator of Business Risk

Year	ROIC
2006	−12.4%
2007	12.8%
2008	21.9%
2009	6.4%
2010	19.6%
2011	15.7%
2012	11.5%
2013	−12.2%
2014	18.0%
Average ROIC	9.0%
Std. Deviation	12.9%



b. Probability Distribution of ROIC: Another Indicator of Business Risk



14-2B Factors that Affect Business Risk

Business risk depends on a number of factors, including the following:

1. *Competition.* If a firm has a monopoly on a necessary product, it will have little risk from competition and thus have stable sales and sales prices. However, monopolistic firms' prices are often regulated, and they may not be able to raise prices enough to cover rising costs. Still, other things held constant, less competition lowers business risk.
2. *Demand variability.* The more stable the demand for a firm's products, other things held constant, the lower its business risk.
3. *Sales price variability.* Firms whose products are sold in volatile markets are exposed to more business risk than firms whose output prices are stable, other things held constant.
4. *Input cost variability.* Firms whose input costs are uncertain have higher business risk.
5. *Product obsolescence.* Firms in high-tech industries like pharmaceuticals and computers depend on a constant stream of new products. The faster its products become obsolete, the greater a firm's business risk.
6. *Foreign risk exposure.* Firms that generate a high percentage of their earnings overseas are subject to earnings declines due to exchange rate fluctuations. They are also exposed to political risk.
7. *Regulatory risk and legal exposure.* Firms that operate in highly regulated industries such as financial services and utilities are subject to changes in the regulatory environment that may have a profound effect on the company's current and future profitability. Other companies face significant legal exposure that could damage the company if they are forced to pay large settlements. For example, in the aftermath of the Deepwater Horizon oil spill in the Gulf of Mexico, BP still faces huge cleanup costs and future legal costs for lost wages, damages to area tourism, and possible legal violations. Tobacco companies and pharmaceutical companies have also incurred huge legal costs after being sued for damages created by their products.
8. *The extent to which costs are fixed: operating leverage.* If a high percentage of its costs are fixed and thus do not decline when demand falls, this increases the firm's business risk. This factor is called *operating leverage*, and it is discussed in the next section.

Each of these factors is determined partly by industry characteristics and partly by managerial decisions. For example, Bigbee could reduce input cost volatility by negotiating long-term labor and supply contracts, but it might have to pay more than the current spot price to obtain such contracts.[9]

14-2C Operating Leverage

As noted earlier, business risk depends in part on the extent to which a firm builds fixed costs into its operations—if fixed costs are high, even a small decline in sales can lead to a large decline in ROIC. So other things held constant, the higher a firm's fixed costs, the greater its business risk. Higher fixed costs are generally associated with more highly automated, capital-intensive firms and industries. However, businesses that employ highly skilled workers who must be retained and paid even during recessions also have relatively high fixed costs, as do firms

[9] *Hedging*, which involves actions that lock in future costs or prices, can also be used to reduce business risk. For example, a jewelry company like Tiffany might buy gold futures to freeze the price it must pay for gold, while a gold mining firm like Newmont Mining might *sell* gold futures to lock in the price it will earn on the gold it produces.

with high product development costs, because the amortization of development costs is a fixed cost.

Operating Leverage
The extent to which fixed costs are used in a firm's operations.

When a high percentage of total costs are fixed, the firm is said to have a high degree of **operating leverage**. In physics, leverage implies the use of a lever to raise a heavy object with a small force. In politics, if people have leverage, their smallest word or action can accomplish a great deal. *In business terminology, a high degree of operating leverage, other factors held constant, implies that a relatively small change in sales results in a large change in ROIC.*

Figure 14.2 illustrates the concept of operating leverage by comparing the results that Bigbee could expect if it used different degrees of operating leverage. Plan A calls for a relatively small amount of fixed costs, $25,000. Here the firm would not have much automated equipment, so its depreciation, maintenance, property taxes, and so forth, would be low. However, the total operating costs line has a relatively steep slope, indicating that variable costs per unit are higher than they would be if the firm used more operating leverage. Plan B calls for a higher level of fixed costs, $70,000. Here the firm uses automated equipment (with which one operator can turn out a few or many units at the same labor cost) to a much larger extent. The break-even point is higher under Plan B—breakeven occurs at 70,000 units under Plan B versus only 50,000 units under Plan A.

Operating Breakeven
The output quantity at which EBIT = 0.

We can calculate the break-even quantity by recognizing that **operating breakeven** occurs when earnings before interest and taxes (EBIT) = 0:[10]

$$EBIT = PQ - VQ - F = 0 \qquad \textbf{14.1}$$

Here P is average sales price per unit of output, Q is units of output, V is variable cost per unit, and F is fixed operating costs. If we solve for the break-even quantity, Q_{BE} we get this expression:

$$Q_{BE} = \frac{F}{P - V} \qquad \textbf{14.1a}$$

Thus, for Plan A,

$$Q_{BE} = \frac{\$25{,}000}{\$2.00 - \$1.50} = 50{,}000 \text{ units}$$

And for Plan B,

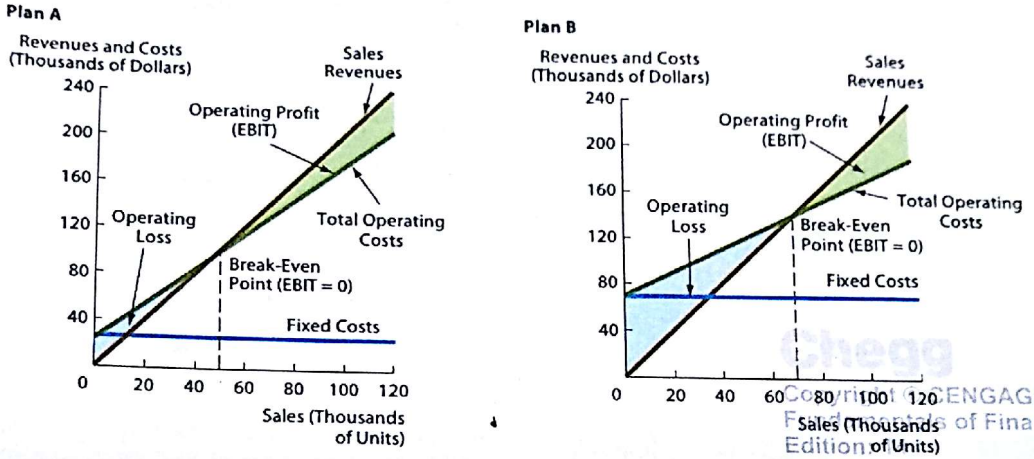
$$Q_{BE} = \frac{\$70{,}000}{\$2.00 - \$1.00} = 70{,}000 \text{ units}$$

How does operating leverage affect business risk? *Other things held constant, the higher a firm's operating leverage, the higher its business risk.* This point is demonstrated in Figure 14.3, where we develop probability distributions for ROIC under Plans A and B.

The top section of Figure 14.3 graphs the probability distribution of sales that was presented in tabular form in Figure 14.2. The sales probability distribution depends on how demand for the product varies, not on whether the product is manufactured by Plan A or by Plan B. Therefore, the same sales probability distribution applies to both production plans. This distribution has expected sales of $200,000; it ranges from zero to about $400,000, with a standard deviation of $\sigma_{Sales} = \$98,793$.

[10]This definition of breakeven does not include any fixed financial costs. If there were fixed financial costs, the firm would suffer an accounting loss at the operating break-even point. We introduce financial costs shortly.

FIGURE 14.2 Illustration of Operating Leverage



	Plan A	Plan B
Price	$ 2.00	$ 2.00
Variable costs	$ 1.50	$ 1.00
Fixed costs	$ 25,000	$ 70,000
Invested capital	$200,000	$200,000
Tax rate	40%	40%

		Plan A						Plan B			
Demand	Probability	Units Sold	Dollar Sales	Operating Costs	Operating Profit (EBIT)	EBIT(1 – T)	ROIC	Operating Costs	Operating Profit (EBIT)	EBIT(1 – T)	ROIC
Terrible	0.05	0	$ 0	$ 25,000	($25,000)	($15,000)	(7.50)%	$ 70,000	($ 70,000)	($42,000)	(21.00)%
Poor	0.20	40,000	80,000	85,000	(5,000)	(3,000)	(1.50)	110,000	(30,000)	(18,000)	(9.00)
Normal	0.50	100,000	200,000	175,000	25,000	15,000	7.50	170,000	30,000	18,000	9.00
Good	0.20	160,000	320,000	265,000	55,000	33,000	16.50	230,000	90,000	54,000	27.00
Wonderful	0.05	200,000	400,000	325,000	75,000	45,000	22.50	270,000	130,000	78,000	39.00
Expected value		100,000	$200,000	$175,000	$25,000	$15,000	7.50%	$170,000	$ 30,000	$18,000	9.00%
Standard deviation					$24,698		7.41%		$ 49,396		14.82%
Coefficient of variation					0.99		0.99		1.65		1.65

Notes:

a. Operating costs = Variable costs + Fixed costs

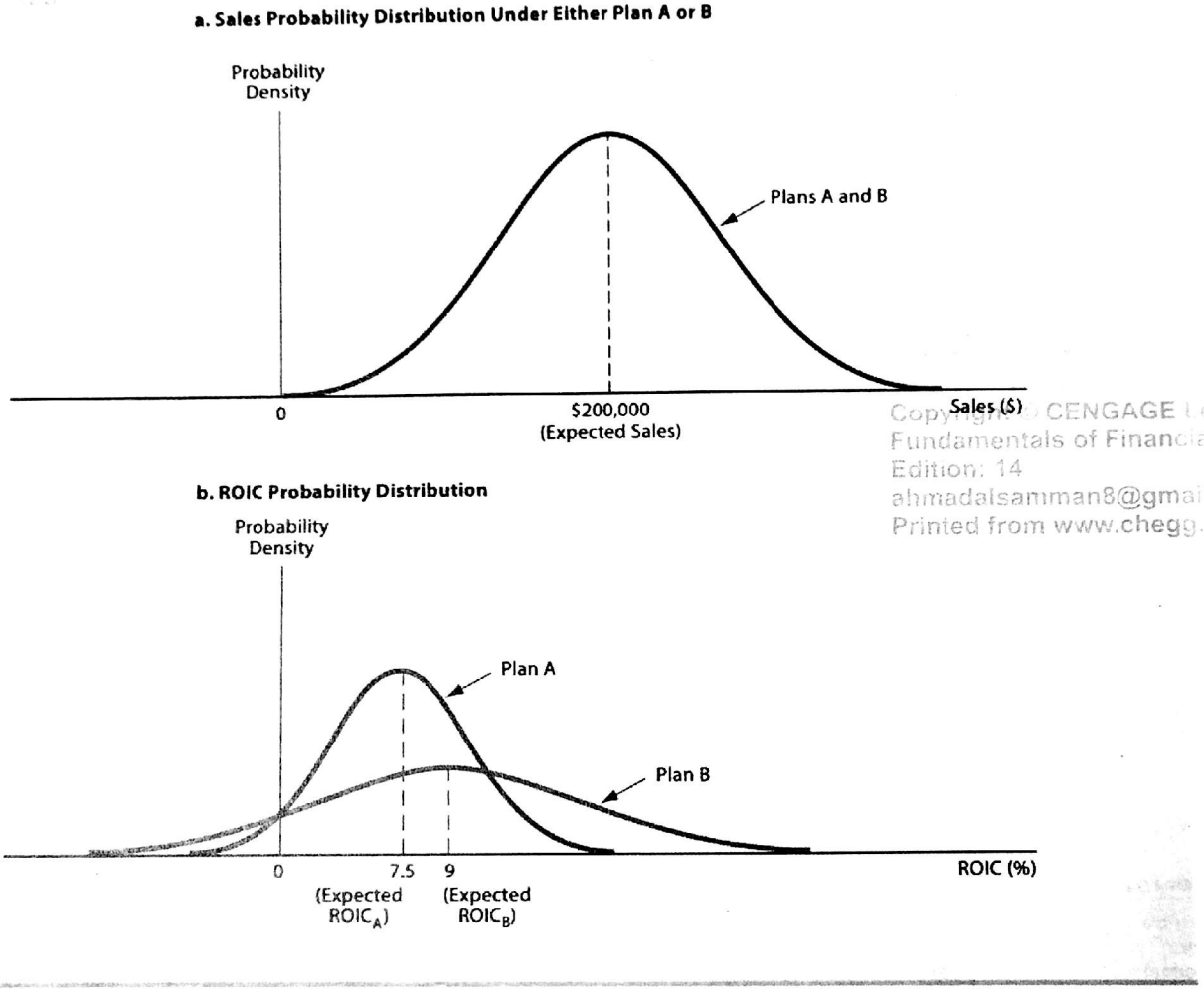
b. Because the company has no debt, Net Income = EBIT(1 – T) and ROE = ROIC, but these equations would no longer hold once the company had outstanding debt.

c. The break-even sales levels for Plans A and B are not shown in the table, but it is 50,000 units or $100,000 for A and 70,000 units or $140,000 for B.

d. The expected values, standard deviations, and coefficients of variation were found using procedures discussed in Chapter 8.

We use the sales probability distribution, together with the operating costs at each sales level, to develop graphs of the ROIC probability distributions under Plans A and B. These are shown in the lower section of Figure 14.3. Plan B has a higher expected ROIC, but this plan also entails a much higher probability of losses. Plan B, the one with more fixed costs and a higher degree of operating leverage, is clearly riskier. *In general, holding other factors constant, the higher the degree of operating leverage, the greater the firm's business risk.* In the discussion that follows, we assume that Bigbee has decided to go ahead with Plan B because its

FIGURE 14.3 Analysis of Business Risk



Note: We are using continuous distributions to approximate the discrete distributions contained in Figure 14.2.

management believes that the higher expected return is sufficient to compensate for the higher risk.

To what extent can firms control their operating leverage? To a large extent, operating leverage is determined by technology. Electric utilities, telephone companies, airlines, steel mills, and chemical companies must have large investments in fixed assets, and this results in high fixed costs and operating leverage. Similarly, pharmaceutical, auto, computer, and other companies must spend heavily to develop new products, and product-development costs increase operating leverage. Grocery stores and service businesses such as accounting and consulting firms, on the other hand, generally have significantly lower fixed costs and therefore lower operating leverage. Still, although industry factors do exert a major influence, all firms have some control over their operating leverage. For example, an electric utility can expand its generating capacity by building either gas-fired or nuclear plants. Nuclear plants would require larger investments and would have higher fixed costs, but their variable operating costs would be relatively low. Gas-fired plants, on the other hand, would require smaller investments and would have lower fixed costs, but the variable costs (for gas) would be high. So, by its capital budgeting decisions, a utility (or any other company) can influence its operating leverage and hence its business risk.

The concept of operating leverage was originally developed for use in capital budgeting. Mutually exclusive projects that involve alternative production methods for a given product often have different degrees of operating leverage and thus different break-even points and different degrees of risk. Bigbee Electronics and many other companies regularly undertake a type of break-even analysis (the sensitivity analysis discussed in Chapter 12) for each proposed project as a part of their regular capital budgeting process. Still, once a corporation's operating leverage has been established, this factor exerts a major influence on its capital structure decision.

14-2D Financial Risk

Financial risk is the additional risk placed on the common stockholders as a result of the decision to finance with debt. Conceptually, stockholders face a certain amount of risk that is inherent in the firm's operations—this is its business risk, defined as the uncertainty inherent in projections of future operating income. If a firm uses debt (financial leverage), this concentrates the business risk on common stockholders. To illustrate, suppose 10 people decide to form a corporation to own and operate a large apartment complex. There is a certain amount of business risk in the operation. If the firm is capitalized only with common equity and if each person buys 10% of the stock, each investor will share equally in the business risk. However, suppose the firm is capitalized with 50% debt and 50% equity, with five of the investors putting up their capital as debt and the other five putting up their money as equity. The debtholders will receive a fixed payment, and it will come before the stockholders receive anything. Also, if the firm goes bankrupt, the debtholders must be paid off before the stockholders receive anything. In this case, the five investors who put up the equity will have to bear all of the business risk; so the common stock will be twice as risky as it would have been had the firm been financed only with equity. *Thus, the use of debt, or* **financial leverage,** *concentrates the firm's business risk on the stockholders.* (In Web Appendix 14A, we describe in more detail the interaction between operating leverage and financial leverage.)

Financial Risk
An increase in stockholders' risk, over and above the firm's basic business risk, resulting from the use of financial leverage.

Financial Leverage
The extent to which fixed-income securities (debt and preferred stock) are used in a firm's capital structure.

To illustrate the business risk concentration, we can extend the Bigbee Electronics example. To date, the company has never used debt, but the treasurer is now considering a possible change in its capital structure. As we mentioned earlier, changes in debt will not affect ROIC, but it will affect the proportion of risk borne by the firm's stockholders. More specifically, changes in the use of debt would cause changes in earnings per share (EPS) as well as changes in risk—both would affect the stock price. To understand the relationship between financial leverage and EPS, first consider Table 14.2, which shows how Bigbee's cost of debt would vary if it used different amounts of

TABLE 14.2 Interest Rates for Bigbee with Different Debt/Capital Ratios

Amount Borrowed[a]	Debt/Capital Ratio	Interest Rate, r_d, on All Debt
$20,000	10%	4.0%
40,000	20	4.3
60,000	30	5.0
80,000	40	5.8
100,000	50	7.2
120,000	60	10.0

Note:
[a]We assume that the firm must borrow in increments of $20,000. We also assume that Bigbee is unable to borrow more than $120,000, which is 60% of its total capital, due to restrictions in its corporate charter.

debt to finance a fixed amount of capital. The higher the percentage of debt in the capital structure, the riskier the debt and, for that reason, the higher the interest rate lenders would charge.

For now, assume that only two financing choices are being considered—remain at 100% equity or shift to 50% debt and 50% equity. We also assume that with no debt, Bigbee has 10,000 shares of common stock outstanding, and if it decides to change its capital structure, common stock would be repurchased at the $20 current stock price. Now consider Table 14.3, which shows how the financing choice would affect Bigbee's profitability and risk.

First, focus on Section I, which assumes that Bigbee uses no debt. Because debt is zero, interest is also zero; hence net income is equal to EBIT(1 – T). ROIC is calculated as EBIT(1 – T) divided by invested capital. Bigbee's invested capital, which is $200,000, equals equity because it has no debt. Net income is then divided by the $200,000 of equity to calculate ROE. Note that Bigbee will receive a tax credit if net income is negative (when demand is terrible or poor). Here we assume that Bigbee's losses can be carried back to offset income earned in the prior year, thus resulting in a tax credit. The ROE at each sales level is then multiplied by the probability of that sales level to calculate the 9% expected ROE. Note that this 9% is the same as that found in Figure 14.2 for Plan B. Finally, because there is no debt, the percentages calculated in the ROIC column are identical to those in the ROE column.

Section I of the table also calculates Bigbee's earnings per share (EPS) for each scenario, under the assumption that the company continues to use no debt. Net income is divided by the 10,000 common shares outstanding to obtain EPS. If demand is terrible, the EPS will be –$4.20, but if demand is wonderful, the EPS will rise to $7.80. The EPS at each sales level is then multiplied by the probability of that level to calculate the expected EPS, which is $1.80 if Bigbee uses no debt. We also calculate the standard deviation of EPS and the coefficient of variation as indicators of the firm's risk at a zero debt ratio: $\sigma_{EPS} = \$2.96$ and $CV_{EPS} = 1.65$.

Now look at Section II, the situation if Bigbee decides to use 50% debt with an interest rate of 7.2%. Neither sales nor operating costs will be affected—the EBIT, the EBIT(1 – T), and the ROIC columns are the same, whether Bigbee has zero debt or 50% debt. However, the company now has $100,000 of debt with a cost of 7.2%; thus, its interest expense is $7,200. This interest must be paid regardless of the state of the economy—if it is not paid, the company will be forced into bankruptcy, and stockholders will be wiped out. Therefore, we show a $7,200 cost in column 6 as a fixed number for all sales levels. Column 7 shows the resulting net income. When net income is divided by the equity investment—which now is only $100,000 because $100,000 of the $200,000 invested capital was financed with debt—we find the ROE under each demand state. If demand is terrible and sales are zero, a very large loss will be incurred, and the ROE will be –46.32%. However, if demand is wonderful, ROE will be 73.68%. The expected ROE is the probability-weighted average, which is 13.68% if the company uses 50% debt. Note that when debt is added to the firm's capital structure, ROE and ROIC are no longer equal.

Typically, using debt increases the expected rate of return for an investment. However, debt also increases risk to the common stockholders. This situation holds with our example—financial leverage raises the expected ROE from 9% to 13.68%, but it also increases the risk of the investment as measured by the coefficient of variation of ROE, which rises from 1.65 to 2.17. Figure 14.4 graphs the data in Table 14.3. It demonstrates that using financial leverage increases the expected ROE but that it also flattens out the probability distribution, increases the probability of a large loss, and thus increases the risk borne by stockholders.

Effects of Financial Leverage: Bigbee Electronics Financed with Zero Debt or 50% Debt **TABLE 14.3**

Section I. Zero Debt	
Debt/Capital ratio	0%
Tax rate	40%
Invested capital	$200,000
Debt	$ 0
Equity	$200,000
Shares outstanding	10,000

Demand for Product (1)	Probability (2)	EBIT (3)	EBIT(1 − T) (4)	ROIC (5)	Interest (6)	Net Income = (EBIT − I)(1 − T) (7)	ROE (8)	EPS[a] (9)
Terrible	0.05	($ 70,000)	($42,000)	(21.00)%	$0	($42,000)	(21.00)%	($4.20)
Poor	0.20	(30,000)	(18,000)	(9.00)	0	(18,000)	(9.00)	(1.80)
Normal	0.50	30,000	18,000	9.00	0	18,000	9.00	1.80
Good	0.20	90,000	54,000	27.00	0	54,000	27.00	5.40
Wonderful	0.05	130,000	78,000	39.00	0	78,000	39.00	7.80
Expected value		$ 30,000	$18,000	9.00%	$0	$18,000	9.00%	$1.80
Standard deviation							14.82%	$2.96
Coefficient of variation							1.65	1.65

Section II. 50% Debt	
Debt/Capital ratio	50%
Tax rate	40%
Invested capital	$200,000
Debt	$100,000
Interest rate	7.2%
Equity	$100,000
Shares outstanding	5,000

Demand for Product (1)	Probability (2)	EBIT (3)	EBIT(1 − T) (4)	ROIC (5)	Interest (6)	Net Income = (EBIT − I)(1 − T) (7)	ROE (8)	EPS[a] (9)
Terrible	0.05	($ 70,000)	($42,000)	(21.00)%	$7,200	($46,320)	(46.32)%	($ 9.26)
Poor	0.20	(30,000)	(18,000)	(9.00)	7,200	(22,320)	(22.32)	(4.46)
Normal	0.50	30,000	18,000	9.00	7,200	13,680	13.68	2.74
Good	0.20	90,000	54,000	27.00	7,200	49,680	49.68	9.94
Wonderful	0.05	130,000	78,000	39.00	7,200	73,680	73.68	14.74
Expected value		$ 30,000	$18,000	9.00%	$7,200	$13,680	13.68%	$ 2.74
Standard deviation							29.64%	$ 5.93
Coefficient of variation							2.17	2.17

Assumptions:

1. In terms of its operating leverage, Bigbee has chosen Plan B. The probability distribution and EBIT are obtained from Figure 14.2.
2. Sales and operating costs (and thus EBIT) are not affected by the financing decision. Therefore, EBIT, EBIT(1−T), and ROIC under both financing plans are identical and are taken from Figure 14.2.
3. All losses can be carried back to offset income in the prior year.

[a]The EPS figures can also be obtained using the following formula in which the numerator amounts to an income statement at a given sales level displayed horizontally:

$$\text{EPS} = \frac{(\text{Sales} - \text{Fixed costs} - \text{Variable costs} - \text{Interest})(1 - \text{Tax rate})}{\text{Shares outstanding}} = \frac{(\text{EBIT} - \text{I})(1 - \text{T})}{\text{Shares outstanding}}$$

For example, with zero debt and sales = $200,000, EPS is $1.80:

$$\text{EPS}_{\text{D/(D+E)}=0\%} = \frac{(\$200{,}000 - \$70{,}000 - \$100{,}000 - \$0)(0.6)}{10{,}000} = \$1.80$$

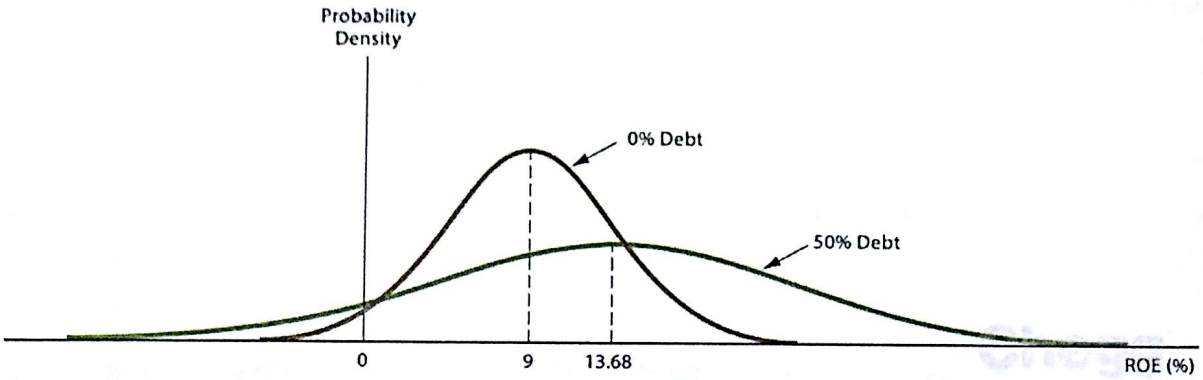
With 50% debt and sales = $200,000, EPS is $2.74:

$$\text{EPS}_{\text{D/(D+E)}=50\%} = \frac{(\$200{,}000 - \$70{,}000 - \$100{,}000 - \$7{,}200)(0.6)}{5{,}000} = \$2.74$$

Refer to the tabular data given in Figure 14.2 to arrive at sales, fixed costs, and variable costs that are used in the preceding equations.

Note: Because the demand for the product has a normal distribution, the probability distribution is symmetrical. Consequently, the expected values equal the values under normal demand. This would not occur under an asymmetrical probability distribution.

FIGURE 14.4 ROE Probability Distributions for Bigbee Electronics, With and Without Financial Leverage



We can also calculate Bigbee's EPS if it uses 50% debt. With Debt = $0, 10,000 shares would be outstanding; but if half the equity was replaced by debt (Debt = $100,000), only 5,000 shares would be outstanding. We can determine the EPS that would result at each of the possible demand levels under the different capital structures.[11] With no debt, EPS would be −$4.20 if demand was terrible, $1.80 if demand was normal, and $7.80 if demand was wonderful. With 50% debt, EPS would be −$9.26 if demand was terrible, $2.74 if demand was normal, and $14.74 if demand was wonderful. Expected EPS would be $1.80 with no debt but $2.74 with 50% financial leverage. Although expected EPS would be much higher if financial leverage was employed, the risk of low, or even negative, EPS would also be higher if debt was used.

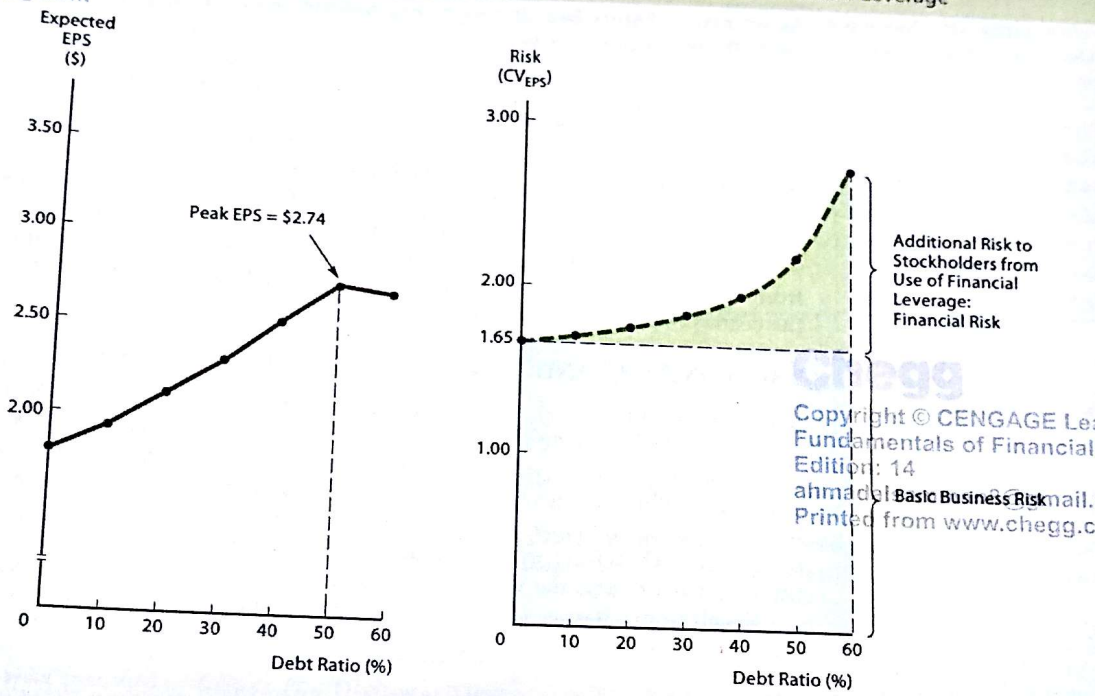
Another view of the relationships among expected EPS, risk, and financial leverage is presented in Figure 14.5. The tabular data in the lower section were calculated in the manner set forth in Table 14.3, and the graphs plot these data. Here we see that expected EPS rises until the firm is financed with 50% debt. Interest charges rise, but this effect is more than offset by the declining number of shares outstanding as debt is substituted for equity. However, EPS peaks at a debt ratio of 50%, beyond which interest rates rise so rapidly that EPS falls in spite of the falling number of shares outstanding.[12] The right graph in Figure 14.5 shows that risk, as measured by the coefficient of variation of EPS, rises continuously and at an increasing rate as debt is substituted for equity.

These examples make it clear that using leverage has both positive and negative effects: Higher leverage increases expected EPS (in this example, until the Debt/Capital ratio equals 50%), but it also increases risk. When determining its optimal capital structure, Bigbee needs to balance these positive and negative effects of leverage. This issue is discussed in the following sections.

[11] We assume in this example that the firm could change its capital structure by repurchasing common stock at its book value of $100,000/5,000 shares = $20 per share. However, the firm may have to pay a higher price to repurchase its stock on the open market. If Bigbee had to pay $22 per share, it could repurchase only $100,000/$22 = 4,545 shares; and in this case, expected EPS would be only $13,680/(10,000 − 4,545) = $13,680/5,455 = $2.51 rather than $2.74.

[12] In this context and in the remainder of this chapter, the debt ratio we are referring to is the Debt/Capital ratio.

FIGURE 14.5 Relationships Among Expected EPS, Risk, and Financial Leverage



Debt/Capital	Expected EPS	Standard Deviation of EPS	Coefficient of Variation
0%[a]	$1.80[a]	$2.96[a]	1.65[a]
10	1.95	3.29	1.69
20	2.12	3.70	1.75
30	2.31	4.23	1.83
40	2.54	4.94	1.95
50[a]	2.74[a]	5.93[a]	2.17[a]
60	2.70	7.41	2.74

Note:

[a]Values for Debt/Capital = 0% and 50% are taken from Table 14.3. Values at other Debt/Capital ratios were calculated similarly.

SELF TEST

What is business risk, and how can it be measured?

What are some determinants of business risk?

Why does business risk vary from industry to industry?

What is operating leverage?

How does operating leverage affect business risk?

What is financial risk, and how does it arise?

Explain this statement: Using financial leverage has both good and bad effects.

14-3 Determining the Optimal Capital Structure

As we saw in Figure 14.5, Bigbee's expected EPS is maximized at a Debt/Capital ratio of 50%. Does that mean that Bigbee's optimal capital structure calls for 50% debt? The answer is a resounding "No!" *The optimal capital structure is the one that maximizes the price of the firm's stock, and this generally calls for a Debt/Capital ratio that is lower than the one that maximizes expected EPS.*

We know that stock prices are positively related to expected earnings but negatively related to higher risk. Therefore, to the extent that higher debt levels raise expected EPS, financial leverage works to increase the stock price. However, higher debt levels also increase the firm's risk, which raises the cost of equity and works to reduce the stock price. So even though increasing the Debt/Capital ratio from 40% to 50% raises EPS, in our example, the higher EPS is more than offset by the corresponding increase in risk.

14-3a WACC and Capital Structure Changes

Managers should set as the target capital structure the debt–equity mix that maximizes the firm's stock price. However, it is difficult to estimate how a given change in the capital structure will affect the stock price. As it turns out, the capital structure that maximizes the stock price also minimizes the WACC; and at times, it is easier to predict how a capital structure change will affect the WACC than the stock price. Therefore, many managers use the estimated relationship between capital structure and the WACC to guide their capital structure decisions.

Recall from Chapter 10 that when a firm uses no preferred stock, the WACC is found as follows:

$$WACC = w_d(r_d)(1 - T) + w_c(r_s)$$

In this expression, w_d and w_c represent the percentage of debt and equity in the firm's capital structure, respectively, and they must sum to 1.0. Note that in Table 14.4 an increase in the Debt/Capital ratio increases the costs of both debt and equity. [The cost of debt, r_d, is taken from Table 14.2 but multiplied by $(1 - T)$ to put it on an after-tax basis.] Bondholders recognize that if a firm has a higher Debt/Capital ratio, this increases the risk of financial distress, which leads to higher interest rates.

In practice, financial managers use financial statement forecasting models to determine how changes in the debt-to-capital ratio will affect the current ratio, times-interest-earned ratio, and EBITDA coverage ratio.[13] They then discuss their projected ratios with bankers and bond rating agencies, which ask probing questions and may make their own adjustments to the firm's forecasts. The bankers and rating agencies compare the firm's ratios with those of other firms in its industry and arrive at a "what if" rating and corresponding interest rate. Moreover, if the company plans to issue bonds to the public, the SEC requires that it inform investors what the coverages will be after the new bonds have been sold. Recognizing all this, sophisticated financial managers use their forecasted ratios to predict how bankers and other lenders will judge their firms' risks and thus their costs of debt. Experienced financial managers and investment bankers can judge quite accurately the effects of capital structure on the cost of debt.

14-3b The Hamada Equation

Increasing the debt ratio increases the risk that bondholders face and thus the cost of debt. More debt also raises the risk borne by stockholders, which raises the cost of equity, r_s. It is harder to quantify leverage's effects on the cost of equity, but a theoretical formula can help measure the effect.

[13] We discuss financial statement forecasts in Chapter 17.

Bigbee's Stock Price and WACC Estimates with Different Debt/Capital Ratios **TABLE 14.4**

w_d = Debt/Capital (1)	Debt/Equity[a] (2)	$r_d(1 - T)$ (3)	Expected EPS (and DPS)[b] (4)	Estimated Beta[c] (5)	$r_s = [r_{RF} + (RP_M)b]$[d] (6)	Estimated Price[e] (7)	Resulting P/E Ratio (8)	WACC[f] (9)
0%	0.00%	2.40%	$1.80	1.00	9.00%	$20.00	11.11×	9.00%
10	11.11	2.40	1.95	1.07	9.40	20.71	10.64	8.70
20	25.00	2.58	2.12	1.15	9.90	21.42	10.10	8.44
30	42.86	3.00	2.31	1.26	10.54	21.95	9.49	8.28
40	66.67	3.48	2.54	1.40	11.40	22.25	8.77	8.23
50	100.00	4.32	2.74	1.60	12.60	21.71	7.94	8.46
60	150.00	6.00	2.70	1.90	14.40	18.75	6.94	9.36

Notes:

[a] $D/E = \frac{w_d}{1 - w_d}$, where w_d = Debt/(Debt + Equity) = Debt/Capital.

[b] Bigbee pays all of its earnings out as dividends, so EPS = DPS.

[c] The firm's unlevered beta, b_U, is 1.0. The remaining betas were calculated using the Hamada equation, given the unlevered beta, tax rate, and D/E ratio as inputs.

[d] We assume that r_{RF} = 3% and RP_M = 6%. Therefore, at Debt/Capital = 0, r_s = 3% + (6%)1.0 = 9%. Other values of r_s are calculated similarly.

[e] Because all earnings are paid out as dividends, no retained earnings will be reinvested in the business and growth in EPS and DPS will be zero. Hence, the zero growth stock price model developed in Chapter 9 can be used to estimate the price of Bigbee's stock. For example, at Debt/Capital = 0,

$$P_0 = \frac{DPS}{r_s} = \frac{\$1.80}{0.09} = \$20$$

Other prices were calculated similarly.

[f] Column 9 values are found with the weighted average cost of capital (WACC) equation developed in Chapter 10:

$$WACC = w_d(r_d)(1 - T) + w_c(r_s)$$

For example, at Debt/Capital = 40%,

$$WACC = 0.4(5.8\%)(0.6) + 0.6(11\ 40\%) = 8.23\%$$

To begin, recall from Chapter 8 that a stock's beta is the relevant measure of risk for a diversified investor. Moreover, beta increases with financial leverage. Robert Hamada formulated the following equation to quantify this effect.[14]

$$b_L = b_U[1 + (1 - T)(D/E)] \qquad 14.2$$

Here b_L is the firm's current beta, which we now assume is based on the existence of some financial leverage, and b_U is the firm's beta if the firm were debt-free, or unlevered.[15] If the firm were debt-free, its beta would depend entirely on its business risk and thus would be a measure of the firm's "basic business risk."

[14] See Robert S. Hamada, "Portfolio Analysis, Market Equilibrium, and Corporation Finance," *Journal of Finance*, vol. 24, no. 1 (March 1969), pp. 13–31.

[15] Note that Equation 14.2 is the original equation that Hamada put forward, and it was based on a set of assumptions. The most notable were (a) that the beta of the company's debt is zero, (b) that the level of debt is constant, and (c) that the values of the company's interest tax shields are discounted at the before-tax cost of debt. Other researchers have derived alternative equations that are based on different assumptions. For example, one commonly used alternative assumes that the company's debt ratio remains constant and that the interest tax shields are discounted at the unlevered cost of equity. In this case, the resulting equation is as follows:

$$b_L = b_U(1 + D/E)$$

D/E is the measure of financial leverage as used in the Hamada equation, and T is the corporate tax rate.[16]

Now recall the CAPM version of the cost of equity:

$$r_s = r_{RF} + (RP_M)b_i$$

Note that beta is the only variable in the equity cost equation that is under management's control. The other two variables, r_{RF} and RP_M are determined by market forces that are beyond the firm's control; but b_L is determined by the firm's operating decisions, which as we saw earlier, affect its basic business risk, and by its capital structure decisions as reflected in its debt (or D/E) ratio.

Unlevered Beta, b_U
The firm's beta coefficient if it has no debt.

We can solve Equation 14.2 to find the **unlevered beta, b_U**, obtaining Equation 14.2a:

$$b_U = b_L/[1 + (1 - T)(D/E)] \qquad \textbf{14.2a}$$

Because the current (levered) beta is known, as are the tax rate and the debt/equity ratio, we can insert values for these known variables and find the unlevered beta. The unlevered beta can then be used in Equation 14.2 with different debt levels to find the levered betas that would exist at those different debt levels. The resulting betas can be used to find the cost of equity at different debt levels.

We can illustrate this with Bigbee Electronics. First, assume that the risk-free rate of return, r_{RF}, is 3% and that the market risk premium, RP_M, is 6%. Next, we need the unlevered beta, b_U. Because Bigbee has no debt, its $D/E = 0$. Therefore, its current 1.0 beta is also its unlevered beta; hence, $b_U = 1.0$. With b_U, r_{RF}, and RP_M specified, we can use Equation 14.2 to estimate Bigbee's betas at different degrees of financial leverage and its resulting cost of equity at each debt ratio.

Bigbee's betas at different debt/equity ratios are shown in column 5 of Table 14.4. The current cost of equity is 9% as shown on the first line of column 6:

$$\begin{aligned} r_s &= r_{RF} + \text{Risk premium} \\ &= 3\% + (6\%)(1.0) \\ &= 3\% + 6\% = 9\% \end{aligned}$$

From this equation, we see that 3% is the risk-free rate and 6% is the firm's risk premium. Because Bigbee currently uses no debt, it has no financial risk. Therefore, the 6% risk premium is attributable entirely to business risk.

If Bigbee changes its capital structure by adding debt, this would increase the risk stockholders would have to bear. That, in turn, would result in a higher risk premium. Conceptually, a firm's cost of equity consists of the following components:

$$r_s = r_{RF} + \text{Premium for business risk} + \text{Premium for financial risk}$$

Figure 14.6, which is based on data shown in column 6 of Table 14.4, graphs Bigbee's costs of equity at different debt ratios. As the figure shows, r_s consists of the 3% risk-free rate, a constant 6% premium for business risk, and a premium for financial risk that starts at zero but rises at an increasing rate as the firm's debt ratio increases.

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[16]Note that w_d is equal to the percentage of debt in the firm's capital structure, and it is equal to Debt/Capital = D/(D + E). So it follows that

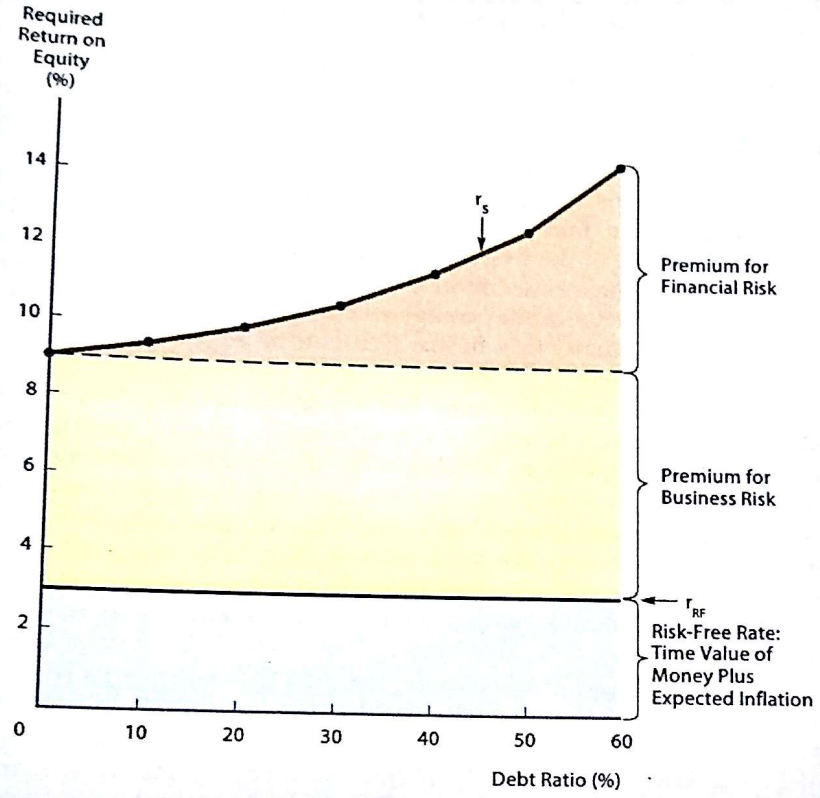
$$\frac{D}{E} = \frac{w_d}{1 - w_d}$$

For example, if the firm has \$40 of debt and \$60 of equity, w_d = D/(D + E) = \$40/(\$40 + \$60) = 0.4. Therefore,

$$\frac{D}{E} = \frac{0.4}{1 - 0.4} = \frac{0.4}{0.6} = 0.6667$$

Note also that Hamada's equation assumes that debt and equity are reported at market values rather than accounting book values. This point is discussed at length in Chapter 16 of Eugene F. Brigham and Phillip R. Daves, *Intermediate Financial Management*, 12th edition (Mason, OH: Cengage Learning, 2016), where feedbacks among capital structure, stock prices, and capital costs are examined.

FIGURE 14.6 Bigbee's Required Rates of Return on Equity at Different Debt Levels



QUICK QUESTION

QUESTION:

Barnes Co. currently has a capital structure that consists of 40% debt and 60% common equity. The company has a 40% tax rate. Currently the levered beta (b_L) on the company's stock is 1.4.

a. What is the company's unlevered beta (b_U)?

b. What would be the company's levered beta (b_L) if Barnes changed its capital structure to 20% debt and 80% common equity?

ANSWER:

a. The company's unlevered beta is calculated as follows:

$$b_U = b_L/[1 + (1 - T)(D/E)]$$
$$b_U = 1.4/[1 + (0.6)(0.4/0.6)]$$
$$b_U = 1.0$$

Notice that $b_U < b_L$. b_U is the firm's beta if it had no debt. Beta is a measure of risk, so with no debt one would anticipate $b_U < b_L$.

b. Using the unlevered beta calculated in part a, the company's new levered beta under the changed capital structure of 20% debt and 80% equity is calculated as follows:

$$b_L = b_U[1 + (1 - T)(D/E)]$$
$$b_L = 1.0[1 + (0.6)(0.2/0.8)]$$
$$b_L = 1.15$$

Again, notice that the new $b_L <$ original b_L. This result is consistent with the reduction in debt level. The risk is lower, and this is reflected in the new lower levered beta.

14-3c The Optimal Capital Structure

Column 9 of Table 14.4 also shows Bigbee's WACCs at different capital structures. Currently, it has no debt; so its debt ratio is zero and its WACC is $r_s = 9\%$. As Bigbee begins to substitute lower-cost debt for higher-cost equity, its WACC declines. However, as the debt ratio rises, the costs of both debt and equity rise, at first slowly but then at a faster and faster rate. Eventually, the increasing costs of the two components offset the fact that more low-cost debt is being used. Indeed, at 40% debt, the WACC hits a minimum of 8.23%; after that, it rises with further increases in the debt ratio.

Another way of looking at this is to note that even though the component cost of equity is higher than that of debt, using only lower-cost debt would not maximize value because of the feedback effects of debt on the costs of debt and equity. For example, if Bigbee used more than 40% debt (say, 50%), it would have more of the less expensive capital component in its capital structure; but this benefit would be more than offset by the fact that the additional debt increases the costs of debt and equity.

Finally, and very importantly, recall that the capital structure that minimizes the WACC is also the capital structure that maximizes the firm's stock price. Bigbee distributes all of its earnings as dividends, so it reinvests no earnings in the business, which leads to an expected growth rate in earnings and dividends of zero. Thus, in Bigbee's case, we can use the zero growth stock price model developed in Chapter 9 to estimate the stock price at each different capital structure. These estimates are shown in column 7 of Table 14.4. Here we see that the stock price first rises with financial leverage, hits a peak of $22.25 at a debt ratio of 40%, and then begins to decline. *Thus, Bigbee's optimal capital structure occurs at a debt ratio of 40%, and that debt ratio both maximizes its stock price and minimizes its WACC.*[17]

The EPS, cost of capital, and stock price data shown in Table 14.4 are plotted in Figure 14.7. As the graph shows, the debt ratio that maximizes Bigbee's expected EPS is 50%. However, the expected stock price is maximized, and the WACC is minimized at a 40% debt ratio. Thus, Bigbee's optimal capital structure calls for 40% debt and 60% equity. Management should set its target capital structure at these ratios, and if the existing ratios are off target, it should move toward that target when new securities are issued.

SELF TEST

What happens to the component costs of debt and equity when the debt ratio is increased? Why does this occur?

Using the Hamada equation, explain the effects of financial leverage on beta.

What is the equation for calculating a firm's unlevered beta?

Use the Hamada equation to calculate the unlevered beta for Firm X with the following data: $b_L = 1.25$, T = 40%, Debt/Capital = 0.42, and Equity/Capital = 0.58. **($b_U = 0.8714$)**

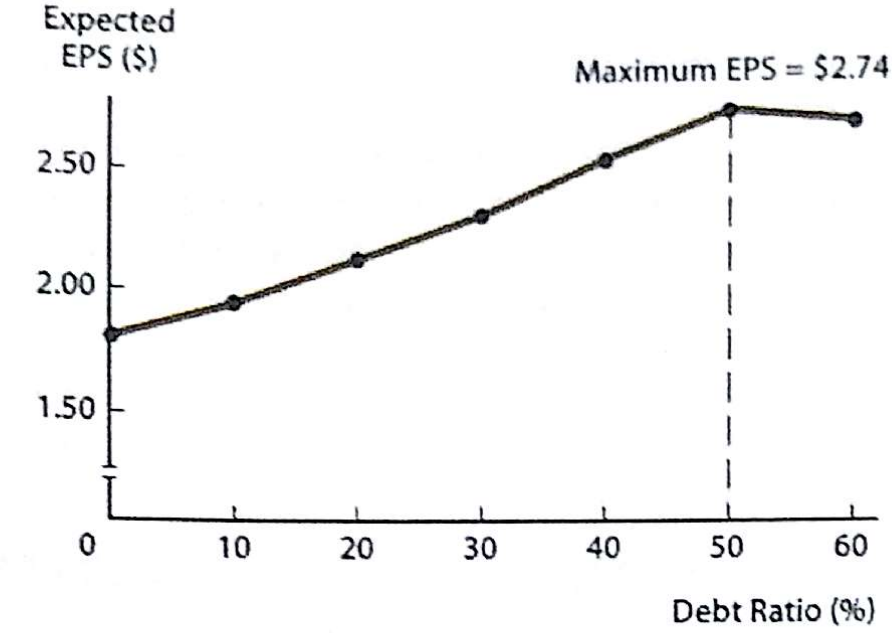
What would be the cost of equity for Firm X at Equity/Capital ratios of 1.0 (no debt) and 0.58 assuming that $r_{RF} = 5\%$ and $RP_M = 4\%$? **(8.49%, 10%)**

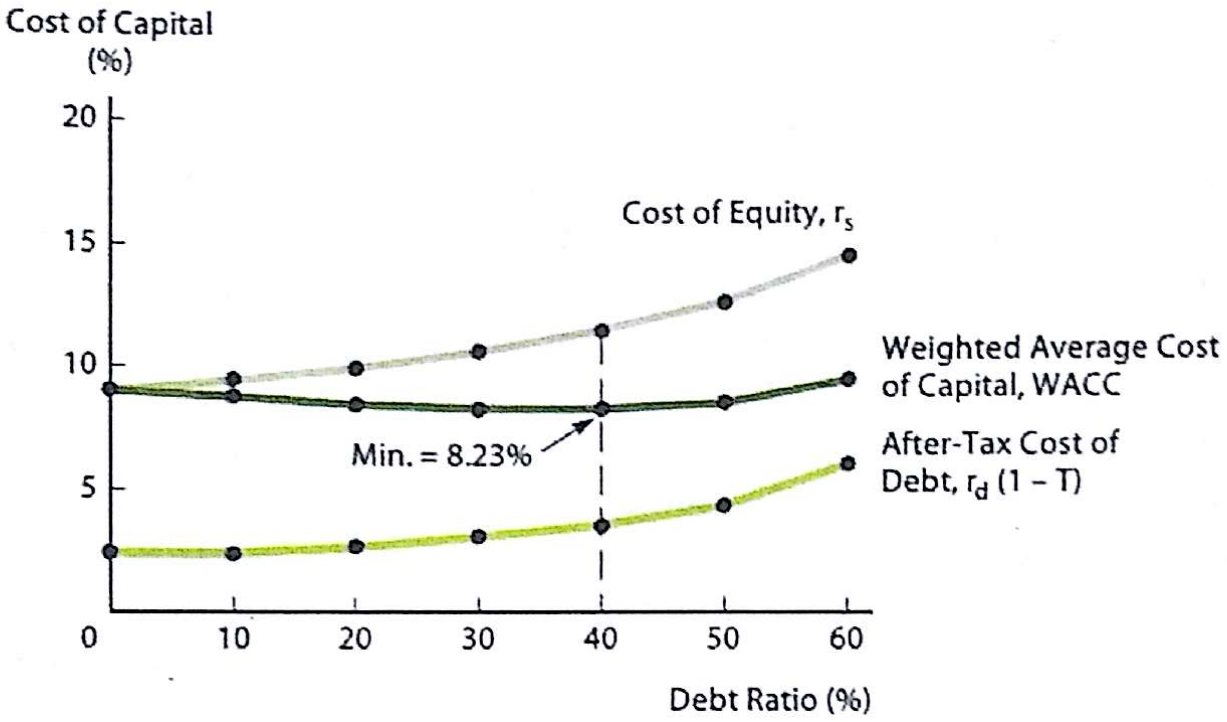
Using a graph and illustrative data, discuss the premiums for financial risk and business risk at different debt levels. Do these premiums vary depending on the debt level? Explain.

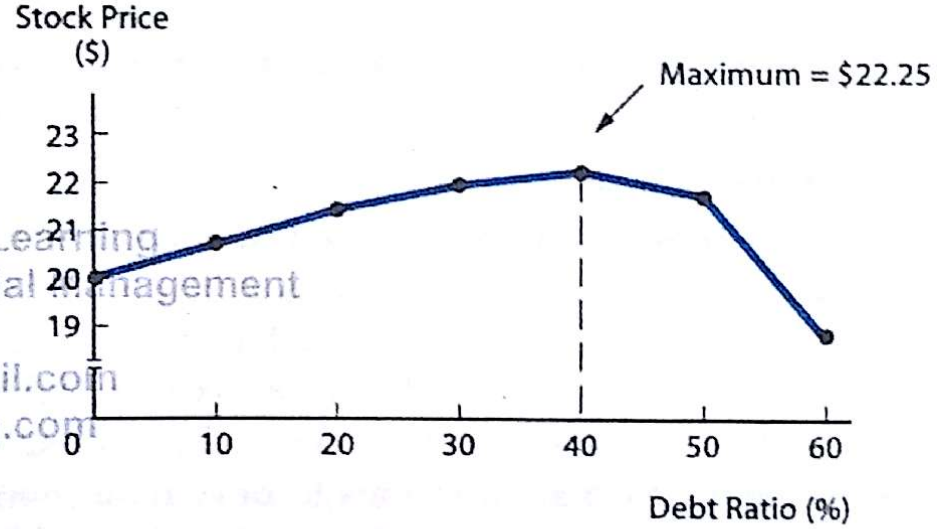
Is expected EPS generally maximized at the optimal capital structure? Explain.

[17] We could also estimate the stock price if some earnings were retained and the expected growth rate were positive. However, this would complicate the analysis, and it is another reason we generally analyze the optimal capital structure decision using the WACC rather than the stock price.

FIGURE 14.7 Effects of Capital Structure on EPS, Cost of Capital and Stock Price







YOGI BERRA ON THE MM PROPOSITION

When a waitress asked Yogi Berra (Baseball Hall of Fame catcher for the New York Yankees) whether he wanted his pizza cut into four pieces or eight, Yogi replied: "Better make it four. I don't think I can eat eight."

Yogi's quip helps convey Modigliani and Miller's basic insight. The firm's choice of leverage divides future cash flows in a way that's like slicing a pizza. MM recognized that if a company's future investments are fixed, it's like fixing the size of the pizza: No information costs means that everyone sees the same pizza; no taxes means that the IRS gets none of the pie; and no "contracting" costs means that nothing sticks to the knife.

So just as the substance of Yogi's meal is unaffected by whether the pizza is sliced into four pieces or eight, the economic substance of the firm is unaffected by whether the liability side of the balance sheet is sliced to include more or less debt under the MM assumptions. Note, though, that whereas the IRS may get none of Yogi's pizza, it is very likely to get some of the firm's income. Yogi's assumptions are more realistic than MM's.

Sources: Lee Green, *Sportswit* (New York: Fawcett Crest, 1984), p. 228; and Michael J. Barclay, Clifford W. Smith, and Ross L. Watts, "The Determinants of Corporate Leverage and Dividend Policies," *Journal of Applied Corporate Finance*, vol. 7, no. 4 (Winter 1995), pp. 4–19.

Modern capital structure theory began in 1958 when Professors Franco Modigliani and Merton Miller (hereafter, MM) published what has been called the most influential finance article ever written.[18] MM proved, under a restrictive set of assumptions, that a firm's value should be unaffected by its capital structure. Put another way, MM's results suggest that it does not matter how a firm finances its operations—hence, that capital structure is irrelevant. However, the assumptions upon which MM's study was based are not realistic, so their results are questionable. Here is a partial listing of their assumptions:

1. There are no brokerage costs.
2. There are no taxes.
3. There are no bankruptcy costs.
4. Investors can borrow at the same rate as corporations.
5. All investors have the same information as management about the firm's future investment opportunities.
6. EBIT is not affected by the use of debt.

Despite the fact that some of these assumptions are unrealistic, MM's irrelevance result is extremely important. By indicating the conditions under which capital structure is irrelevant, MM provided clues about what is required to make capital structure relevant and, therefore, to affect a firm's value. MM's work marked the beginning of modern capital structure research, and subsequent research has focused on relaxing the MM assumptions to develop a more robust and realistic theory. Research in this area is quite extensive, but the highlights are summarized in the following sections.

14-4a The Effect of Taxes[19]

MM's original 1958 paper was criticized harshly, and they published a follow-up in 1963 that relaxed the assumption of no corporate taxes.[20] They recognized that the Tax Code allows corporations to deduct interest payments as an expense, but

[18]Franco Modigliani and Merton H. Miller, "The Cost of Capital, Corporation Finance, and the Theory of Investment," *American Economic Review*, vol. 48, no. 3 (June 1958), pp. 261–297. Both Modigliani and Miller won Nobel Prizes for their work.

[19]This section is relatively technical, and it can be omitted without a loss of continuity.

[20]Franco Modigliani and Merton H. Miller, "Corporate Income Taxes and the Cost of Capital: A Correction," *American Economic Review*, vol. 53, no. 3 (June 1963), pp. 433–443.

dividend payments to stockholders are not deductible. This differential treatment encourages corporations to use debt in their capital structures. Indeed, MM demonstrated that if all their other assumptions hold, this differential treatment leads to an optimal capital structure of 100% debt.

MM's 1963 work was modified several years later by Merton Miller (this time without Modigliani), when he brought in the effects of personal taxes.[21] Miller noted that bonds pay interest, which is taxed as personal income at rates going up to 39.6%, while income from stocks comes partly from dividends and partly from capital gains. Further, long-term capital gains are taxed at a maximum rate of 15% (20% in 2014 for high-income taxpayers), and this tax can be deferred until the stock is sold and the gain realized. If a stock is held until the owner dies, no capital gains tax must be paid. So on balance, returns on common stocks are taxed at lower effective rates than returns on debt.[22]

Because of the tax situation, Miller argued that investors are willing to accept relatively low before-tax returns on stocks as compared to the before-tax returns on bonds. For example, an investor in the 39.6% tax bracket might require a 10% pretax return on Bigbee's bonds, which would result in a $10\%(1 - T) = 10\%(0.604) = 6.04\%$ after-tax return. Bigbee's stock is riskier than its bonds, so the investor would require a higher after-tax return (say, 8%) on the stock. Because the stock's returns (either dividends or capital gains) would be taxed at 20%, a pretax return of $8\%/(1 - T) = 8.0\%/0.80 = 10.0\%$ would provide the required 8.0% after-tax return. In this example, the interest rate on the bonds would be 10%, the same as the required return on the stock, r_s. Thus, the more favorable treatment of income on the stock would cause investors to accept the same before-tax returns on the stock and on the bond.[23]

As Miller pointed out, (1) the *deductibility of interest* favors the use of debt financing, but (2) the *more favorable tax treatment of income from stocks* lowers the required rates of return on stocks and thus favors the use of equity. It is difficult to specify the net effect of these two factors. However, most observers believe that interest deductibility has a stronger effect and hence that our tax system favors the corporate use of debt. Still, that effect is certainly reduced by the lower taxes on stock income. Duke University professor John Graham estimated the overall tax benefits of debt financing.[24] He concluded that the tax benefits associated with debt financing represent about 7% of the average firm's value; so if a leverage-free firm decided to use an average amount of debt, its value would rise by 7%.

14-4B The Effect of Potential Bankruptcy

MM's irrelevance results also depend on the assumption that firms don't go bankrupt and hence that bankruptcy costs are irrelevant. However, in practice, bankruptcy exists, and it can be quite costly. Firms in bankruptcy have high legal and accounting expenses, and they have a hard time retaining customers, suppliers, and employees. Moreover, bankruptcy often forces a firm to liquidate assets for less than they would be worth if the firm continued to operate. Assets such as

[21]Merton H. Miller, "Debt and Taxes," *Journal of Finance*, vol. 32, no. 2 (May 1977), pp. 261–275.

[22]When Miller wrote his article, dividends were taxed at a maximum rate of 70% and capital gains at a much lower rate. Today (2014) dividends and capital gains are taxed at a maximum rate of 20% for high-income taxpayers, but interest is taxed at a maximum rate of 39.6%. [Capital gains can be caught by the Alternative Minimum Tax (AMT), in which case they are taxed at either 26% or 28% depending on one's income bracket.] These tax law changes would not affect Miller's final conclusion.

[23]The situation here is similar to that involving tax-exempt municipal bonds versus taxable bonds.

[24]John R. Graham, "How Big Are the Tax Benefits of Debt?" *Journal of Finance*, vol. 55, no. 5 (October 2000), pp. 1901–1941; and John R. Graham, "Estimating the Tax Benefits of Debt," *Journal of Applied Corporate Finance*, vol. 14, no. 1 (Spring 2001), pp. 42–54.

plant and equipment are often illiquid because they are configured to a company's individual needs and because they are difficult to disassemble and move.

Note too that the *threat of bankruptcy*, not just bankruptcy per se, brings about these problems. If they become concerned about the firm's future, key employees start "jumping ship"; suppliers start refusing to grant credit; customers begin seeking more stable suppliers; and lenders start demanding higher interest rates and imposing stricter loan covenants.

Bankruptcy-related problems are likely to increase the more debt a firm has in its capital structure. Therefore, bankruptcy costs discourage firms from pushing their use of debt to excessive levels. Note too that bankruptcy-related costs have two components: (1) the probability of their occurrence and (2) the costs that will be incurred if financial distress arises. A firm whose earnings are relatively volatile, all else equal, faces a greater chance of bankruptcy and thus should use less debt than a more stable firm. This is consistent with our earlier point that firms with high operating leverage (and thus greater business risk) should limit their use of financial leverage. Likewise, firms whose assets are illiquid and would have to be sold at "fire sale" prices should limit their use of debt financing.

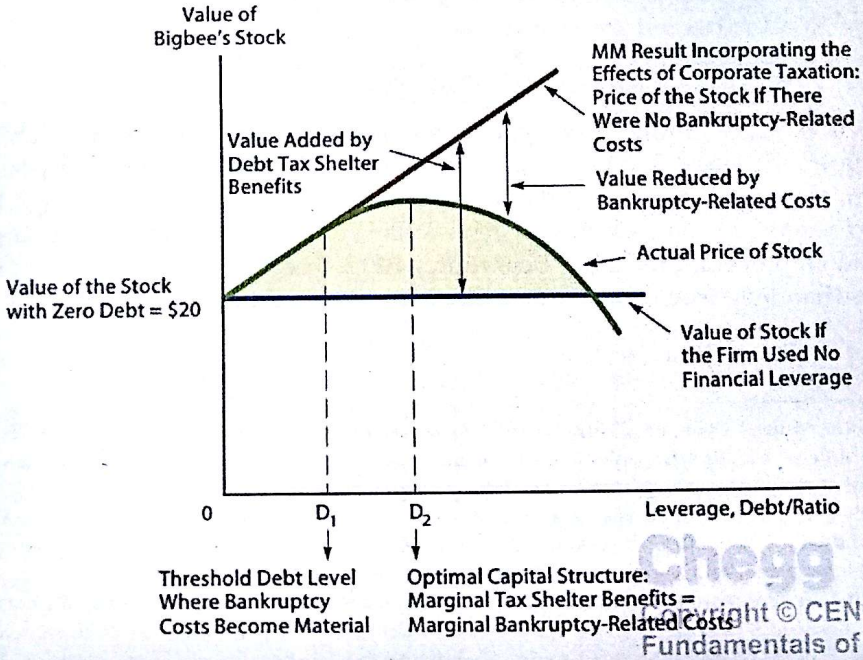
14-4c Trade-Off Theory

The preceding arguments led to the development of what is called "the trade-off theory of leverage." This theory states that firms trade off the tax benefits of debt financing against problems caused by potential bankruptcy. A summary of the **trade-off theory** is expressed graphically in Figure 14.8. Here are some observations about the figure:

Trade-Off Theory
The capital structure theory that states that firms trade off the tax benefits of debt financing against problems caused by potential bankruptcy.

1. The fact that interest paid is a deductible expense makes debt less expensive than common or preferred stock. In effect, the government pays part of the cost of debt—or to put it another way, debt provides *tax shelter benefits*. As a result, using more debt reduces taxes and thus allows more of the firm's operating income (EBIT) to flow through to investors. This factor, on which

FIGURE 14.8 Effect of Financial Leverage on the Value of Bigbee's Stock



MM focused, tends to raise the stock's price. Indeed, under the assumptions of MM's original paper, the stock price would be maximized at 100% debt. The line labeled "MM Result Incorporating the Effects of Corporate Taxation" in Figure 14.8 expresses the relationship between stock prices and debt under their assumptions.

2. In the real world, firms have target debt ratios that call for less than 100% debt to limit the adverse effects of potential bankruptcy.
3. There is some threshold level of debt, labeled D_1 in Figure 14.8, below which the probability of bankruptcy is so low as to be immaterial. Beyond D_1, however, bankruptcy-related costs become increasingly important, and they begin to offset the tax benefits of debt. In the range from D_1 to D_2, bankruptcy-related costs reduce but do not completely offset the tax benefits of debt; so the firm's stock price continues to rise (but at a decreasing rate) as its debt ratio increases. However, beyond D_2, bankruptcy-related costs exceed the tax benefits, so from this point on, increasing the debt ratio lowers the stock price. Therefore, D_2 is the optimal capital structure, the one where the stock price is maximized. Of course, D_1 and D_2 vary from firm to firm depending on business risk and bankruptcy costs, and they can change for a given firm over time.
4. Although theoretical and empirical work supports the general shape of the curves in Figures 14.7 and 14.8, these graphs must be taken as approximations, not as precisely defined functions. The numbers in Figure 14.7 are rounded to two decimal places, but that is merely for illustrative purposes—the numbers are not nearly that accurate because the graph is based on estimates.
5. Another disturbing aspect of capital structure theory expressed in Figure 14.8 is the fact that many large, successful firms such as Intel and Microsoft use far less debt than the theory suggests. This point led to the development of signaling theory, which is discussed in the next section.

14-4d Signaling Theory

MM assumed that everyone—investors and managers alike—has the same information about a firm's prospects. This is called **symmetric information**. However, in fact, managers often have better information than outside investors. This is called **asymmetric information**, and it has an important effect on the optimal capital structure. To see why, consider two situations, one where the company's managers know that its prospects are extremely favorable (Firm F) and one where the managers know that the future looks unfavorable (Firm U).

Symmetric Information
The situation where investors and managers have identical information about firms' prospects.

Asymmetric Information
The situation where managers have different (better) information about firms' prospects than do investors.

Now suppose Firm F's R&D labs have just discovered a nonpatentable cure for the common cold. They want to keep the new product a secret as long as possible to delay competitors' entry into the market. New plants must be built to make the new product, so capital must be raised. But how should Firm F raise the needed capital? If it sells stock, when profits from the new product start flowing in, the price of the stock will rise sharply, and purchasers of the new stock will make a bonanza. The current stockholders (including the managers) also will do well, but not as well as they would have done if the company had not sold stock before the price increased. In that case, they would not have had to share the benefits of the new product with the new stockholders. *Therefore, we would expect a firm with very favorable prospects to avoid selling stock and instead raise any required new capital by using new debt, even if this moved its debt ratio beyond the target level.*[25]

[25]It would be illegal for Firm F's managers to personally purchase more shares on the basis of their inside knowledge of the new product. They could be sent to jail if they did.

Now consider Firm U. Suppose its managers have information that new orders are off sharply because a competitor has installed new technology that improved the quality of its products. Firm U must upgrade its own facilities at a high cost just to maintain current sales. As a result, its return on investment will fall (but not by as much as if it took no action, which would lead to a 100% loss through bankruptcy). How should Firm U raise the needed capital? Here the situation is just the reverse of that facing Firm F—Firm U will want to sell stock so that some of the adverse consequences will be borne by new investors. *Therefore, a firm with unfavorable prospects would want to finance with stock, which would mean bringing in new investors to share the losses.*[26]

The conclusion from all this is that firms with extremely bright prospects prefer not to finance through new stock offerings, whereas firms with poor prospects do like to finance with outside equity. How should you, as an investor, react to this conclusion? You ought to say, "If I see that a company plans to issue new stock, I should worry because I know that management would not want to issue stock if future prospects looked good. However, management would want to issue stock if things looked bad. Therefore, I should lower my estimate of the firm's value, other things held constant, if it plans to issue new stock."

If you gave that answer, your views are consistent with those of sophisticated portfolio managers. *In a nutshell, the announcement of a stock offering is generally taken as a* **signal** *that the firm's prospects as seen by its management are not bright.* This, in turn, suggests that when a firm announces a new stock offering, more often than not, the price of its stock will decline.[27] Empirical studies have shown that this situation does exist.[28]

Signal
An action taken by a firm's management that provides clues to investors about how management views the firm's prospects.

What are the implications of all this for capital structure decisions? Issuing stock emits a negative signal and thus tends to depress the stock price; so even if the company's prospects are bright, a firm should, in normal times, maintain a **reserve borrowing capacity** that can be used in the event that some especially good investment opportunity comes along. *This means that firms should, in normal times, use more equity and less debt than is suggested by the tax benefit/bankruptcy cost trade-off model illustrated in Figure 14.8.*

Reserve Borrowing Capacity
The ability to borrow money at a reasonable cost when good investment opportunities arise. Firms often use less debt than specified by the MM optimal capital structure in "normal" times to ensure that they can obtain debt capital later if necessary.

14-4E Using Debt Financing to Constrain Managers

In Chapter 1, we stated that conflicts of interest may arise if managers and shareholders have different objectives. Such conflicts are particularly likely when the firm has more cash than is needed to support its core operations. Managers often use excess cash to finance their pet projects or for perquisites such as plush offices, corporate jets, and skyboxes at sports arenas, all of which may do little to benefit stock prices.[29] By contrast, managers with more limited free cash flow are less able to make wasteful expenditures.

Firms can reduce excess cash flow in a variety of ways. One way is to funnel some of it back to shareholders through higher dividends or stock repurchases. Another alternative is to tilt the target capital structure toward more debt in the hope that higher debt service requirements will force managers to become more disciplined. If debt is not serviced as required, the

[26]Of course, Firm U would have to make certain disclosures when it offered new shares to the public, but it might be able to meet the legal requirements without fully disclosing management's worst fears.
[27]Stock issues are more of a negative signal for mature companies than for new, rapidly growing firms, where investors expect rapid growth to require additional equity.
[28]See Paul Asquith and David W. Mullins Jr., "The Impact of Initiating Dividend Payments on Shareholders' Wealth," *Journal of Business*, vol. 56, no. 1 (January 1983), pp. 77–96.
[29]If you don't believe that corporate managers can waste money, read Bryan Burrough, *Barbarians at the Gate: The Fall of RJR Nabisco* (New York: Harper & Row, 1990), the story of the takeover of RJR-Nabisco.

firm will be forced into bankruptcy, in which case its managers would lose their jobs. Therefore, a manager is less likely to buy an expensive corporate jet if the firm has large debt service requirements.

A leveraged buyout (LBO) is a good way to reduce excess cash flow. In an LBO, debt is used to finance the purchase of a high percentage of the company's shares. Indeed, the projected savings from reducing frivolous waste has motivated quite a few leveraged buyouts. As noted, high debt payments after the LBO force managers to conserve cash by eliminating unnecessary expenditures.

Of course, increasing debt and reducing free cash flow has its downside: It increases the risk of bankruptcy. Economist Ben Bernanke (who is the former Federal Reserve chairman) has argued that adding debt to a firm's capital structure is like putting a dagger into the steering wheel of a car.[30] The dagger—which points toward your chest—motivates you to drive more carefully; but you may get stabbed if someone runs into you, even if you are being careful. The analogy applies to corporations in the following sense: Higher debt forces managers to be more careful with shareholders' money, but even well-run firms can face bankruptcy (get stabbed) if some event beyond their control, such as a war, an earthquake, a strike, or a recession, occurs. To complete the analogy, the capital structure decision comes down to deciding how big a dagger stockholders should use to keep managers in line.

If you find the discussion of capital structure theory imprecise and somewhat confusing, you're not alone. In truth, not even the former chairman of the Federal Reserve Board knows how to identify a firm's precise optimal capital structure or how to measure the effects of capital structure changes on stock prices and the cost of capital. In practice, capital structure decisions must be made using a combination of judgment and numerical analysis. Still, an understanding of the theoretical issues presented here can help you make better judgments about capital structure issues.

14-4f Pecking Order Hypothesis

Yet another factor that may influence capital structures is the idea that managers have a preferred **pecking order** when it comes to raising capital and that this pecking order affects capital structure decisions.[31] We know that firms often finance in the following order: Their first source of funds is accounts payable and accruals. Retained earnings generated during the current year would be the next source. Then, if the amount of retained earnings is not sufficient to cover capital requirements, firms issue debt. Finally, and only as a last resort, they issue new common stock.

Pecking Order
The sequence in which firms prefer to raise capital: first spontaneous credit, then retained earnings, then other debt, and finally new common stock.

Why might it be logical for a firm to follow this pecking order? First, no flotation costs are incurred to raise capital as spontaneous credit or retained earnings, and costs are relatively low when issuing new debt. However, flotation costs for new stock issues are quite high, and the existence of asymmetric information/signaling effects makes it even more undesirable to finance with new common stock. So, the pecking order theory is logical, and it can influence a firm's capital structure, although there is still some debate about its relative importance.[32]

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[30]Ben Bernanke, "Is There Too Much Corporate Debt?" Federal Reserve Bank of Philadelphia, *Business Review* (September/October 1989), pp. 3–13.

[31]See Jonathan Baskin, "An Empirical Investigation of the Pecking Order Hypothesis," *Financial Management*, vol. 18 (Spring 1989), pp. 26–35.

[32]See Murray Frank and V.K. Goyal, "Testing the Pecking Order Theory of Capital Structure," *Journal of Financial Economics*, vol. 67, no. 2 (February 2003), pp. 217–248.

14-4g Windows of Opportunity

Windows of Opportunity
The occasion where a company's managers adjust its firm's capital structure to take advantage of certain market situations.

If a company's stock is selling for a price different than its intrinsic value, the company's managers can adjust the firm's capital structure to take advantage of this mispricing. When a company's stock is overvalued (trading for more than its intrinsic value), its managers can take the opportunity to issue new equity at a time when its market value is relatively high. Likewise, managers may choose to repurchase stock when the firm's stock is undervalued. A study by Malcolm Baker and Jeffrey Wurgler documents that many companies take advantage of these **windows of opportunity**, and they argue that these attempts to time the market have had a profound effect on these companies' capital structures.[33]

SELF TEST

Why does MM's theory with taxes lead to 100% debt?

How would an increase in corporate taxes tend to affect an average firm's capital structure? What about an increase in the personal tax rate?

Explain what asymmetric information means, and how signals affect capital structure decisions.

What is meant by reserve borrowing capacity, and why is it important to firms?

How can the use of debt serve to discipline managers?

What is the pecking order hypothesis, and how does it influence firms' capital structures?

How do "windows of opportunity" impact a firm's capital structure?

14-5 Checklist for Capital Structure Decisions

In addition to the types of analyses discussed previously, firms generally consider the following factors when making capital structure decisions:

1. *Sales stability.* A firm whose sales are relatively stable can safely take on more debt and incur higher fixed charges than a company with unstable sales. Utility companies, because of their stable demand, historically have been able to use more financial leverage than can industrial firms.
2. *Asset structure.* Many companies also take their desired cash holdings into account when setting their target capital structure. Holding other factors constant, a company is able to take on more debt if it has more cash on the balance sheet. For this reason, some analysts also evaluate an alternative measure, **net debt**, which subtracts cash and equivalent securities from the company's total debt:

Net Debt
Equal to short-term debt plus long-term debt less cash and equivalents. Companies often look at this measure when setting their target capital structure.

$$\text{Net debt} = \text{Short-term debt} + \text{Long-term debt} - \text{Cash and equivalents}$$

Looking at Table 14.1, we see that Caterpillar has $41.6 billion in net debt ($47.7 billion in total debt minus $6.1 billion in cash and equivalents). Holding other factors constant, firms that have more cash or other assets

[33] See Malcolm Baker and Jeffrey Wurgler, "Market Timing and Capital Structure," *The Journal of Finance*, vol. 57, no. 1 (February 2002), pp. 1–32.

that are suitable as security for loans tend to use debt relatively heavily. General-purpose assets that can be used by many businesses make good collateral, whereas special-purpose assets do not. Thus, real estate companies are usually highly leveraged, whereas companies involved in technological research are not.[34]

3. *Operating leverage.* Other things the same, a firm with less operating leverage is better able to employ financial leverage because it will have less business risk.
4. *Growth rate.* Other things the same, faster-growing firms must rely more heavily on external capital. Further, the flotation cost involved in selling common stock exceeds that incurred when selling debt, which encourages rapidly growing firms to rely more heavily on debt. At the same time, however, those firms often face higher uncertainty, which tends to reduce their willingness to use debt.
5. *Profitability.* It is often observed that firms with very high rates of return on investment use relatively little debt. Although there is no theoretical justification for this fact, one practical explanation is that very profitable firms such as Intel, Microsoft, and Google do not need to do much debt financing. Their high rates of return enable them to do most of their financing with internally generated funds.
6. *Taxes.* Interest is a deductible expense, and deductions are most valuable to firms with high tax rates. Therefore, the higher a firm's tax rate, the greater the advantage of debt.
7. *Control.* The effect of debt versus stock on a management's control position can influence capital structure. If management currently has voting control (more than 50% of the stock) but is not in a position to buy any more stock, it may choose debt for new financings. On the other hand, management may decide to use equity if the firm's financial situation is so weak that the use of debt might subject it to serious risk of default. The reason? If the firm goes into default, managers will probably lose their jobs. However, if too little debt is used, management runs the risk of a takeover. Thus, control considerations can lead to the use of debt or equity because the type of capital that best protects management varies from situation to situation. In any event, if management is at all insecure, it will consider the control situation.
8. *Management attitudes.* No one can prove that one capital structure will lead to higher stock prices than another. Management, then, can exercise its own judgment about the proper capital structure. Some managers tend to be relatively conservative and thus use less debt than an average firm in the industry, whereas aggressive managers use a relatively high percentage of debt in their quest for higher profits.
9. *Lender and rating agency attitudes.* Regardless of a manager's analysis of the proper leverage factors for his or her firm, the attitudes of lenders and rating agencies frequently influence financial structure decisions. Corporations often discuss their capital structures with lenders and rating agencies and give much weight to their advice. For example, Moody's and Standard & Poor's

[34]Two capital structure issues that we do not address in this chapter relate to how long-term leases and convertible securities impact the financing mix. Leases are de facto a substitute for debt, so it would be appropriate to determine the present value of the firm's future lease payments and treat them as debt. Thus, if we were examining two firms with debt ratios of 50%, but one leases many of its assets and does not reflect those transactions on its balance sheet, then it is really more leveraged than the other firm. Convertibles are bonds (or preferred stocks) that can be converted into common stock at the option of the holder. Before conversion, these securities technically increase the firm's financial leverage, but immediately after conversion leverage declines. For a precise examination of a firm's leverage, it would be useful to estimate the likely timing of conversion and take it into account. However, such an analysis goes beyond the scope of an introductory text.

recently told one large utility that its bonds would be downgraded if it issued more bonds. This influenced its decision, and its next financing was with common equity.

10. *Market conditions.* Conditions in the stock and bond markets undergo long- and short-run changes that can have an important bearing on a firm's optimal capital structure. For example, during a recent credit crunch, the junk bond market dried up and there simply was no market at a "reasonable" interest rate for any new long-term bonds rated below BBB. Therefore, low-rated companies in need of capital were forced to go to the stock market or to the short-term debt market, regardless of their target capital structures. When conditions eased, however, these companies sold long-term bonds to get their capital structures back on target.

11. *The firm's internal condition.* A firm's own internal condition can also have a bearing on its target capital structure. For example, suppose a firm just successfully completed an R&D program and forecasts higher earnings in the immediate future. However, the new earnings are not yet anticipated by investors and are not reflected in the stock price. This company would not want to issue stock—it would prefer to finance with debt until the higher earnings materialize and are reflected in the stock price. Then it could sell an issue of common stock, use the proceeds to retire the debt, and return to its target capital structure. This point was discussed earlier in connection with asymmetric information and signaling.

12. *Financial flexibility.* An astute corporate treasurer made this statement to the authors:

> *Our company can earn a lot more money from good capital budgeting and operating decisions than from good financing decisions. Indeed, we are not sure exactly how financing decisions affect our stock price, but we know for sure that having to turn down promising ventures because funds are not available will reduce our long-run profitability. For this reason, my primary goal as treasurer is to always be in a position to raise the capital needed to support operations.*
>
> *We also know that when times are good, we can raise capital with either stocks or bonds, but when times are bad, suppliers of capital are much more willing to make funds available if we give them a stronger position, and this means debt. Further, when we sell a new issue of stock, this sends a negative "signal" to investors, so stock sales by a mature company such as ours are not desirable.*

Combining these thoughts gives rise to the goal of maintaining financial flexibility, which from an operational viewpoint means maintaining adequate "reserve borrowing capacity." Determining the "adequate" reserve is based on judgment, but it clearly depends on the firm's forecasted need for funds, predicted capital market conditions, management's confidence in its forecasts, and the consequences of a capital shortage.

SELF TEST

How does sales stability affect the target capital structure?

How do the types of assets used affect a firm's capital structure?

How do taxes affect the target capital structure?

How do the attitudes of lenders and rating agencies affect capital structure?

How does the firm's internal condition affect its actual capital structure?

What is financial flexibility, and is it increased or decreased by a high debt ratio? Explain.

14-6 Variations in Capital Structures

As might be expected, wide variations in the use of financial leverage occur across industries and among the individual firms in each industry. Table 14.5 illustrates differences for selected companies in different industries, the ranking is in ascending order of the company's long-term debt ratio.[35]

Petroleum, aerospace, biotechnology, and steel companies use relatively little debt because their industries tend to be cyclical, oriented toward research, or subject to huge product liability suits. On the other hand, grocery stores, utility companies, and airlines use debt relatively heavily because their fixed assets make good security for mortgage bonds and their relatively stable sales make it safe to carry more than average debt.

The times-interest-earned (TIE) ratio gives an indication of how vulnerable the company is to financial distress. This ratio depends on three factors: (1) the percentage of debt, (2) the interest rate on the debt, and (3) the company's profitability. Generally, low-leveraged companies such as Google and Eli Lilly have high coverage ratios, whereas companies like ConAgra, Kroger, and American Airlines, which have financed heavily with debt, have lower coverage ratios.

Wide variations in capital structures also exist among firms in given industries. This can be seen from Table 14.5. For example, although the average ratio of long-term debt to total capital in 2014 for the petroleum industry was 18.03%, BP had a ratio of 25.93%. Thus, factors unique to individual firms, including managerial attitudes, play an important role in setting target capital structures.

Capital Structure Percentages, 2014: Selected Companies Ranked by Company Long-Term Debt Ratios[a] **TABLE 14.5**

	Company		Industry		
Name	Long-Term Debt Ratio	Times-Interest-Earned Ratio	Description	Long-Term Debt Ratio	Times-Interest-Earned Ratio
GOOGLE	3.85%	176.42×	Internet Content	3.85%	113.47×
Eli Lilly	22.48	31.64	Pharmaceuticals	25.37	20.66
BP	25.93	6.55	Petroleum	18.03	10.38
NUCOR	36.71	6.28	Steel	30.07	0.52
CSX	45.95	6.04	Railroads	35.48	11.04
McDonald's	46.24	16.44	Restaurants	46.52	14.16
Rockwell Collins	47.37	21.88	Aerospace	37.11	12.98
TECO Energy	54.95	2.86	Electric Utilities	50.74	2.71
ConAgra Foods	60.94	3.88	Food Processing	55.36	9.62
Kroger	64.16	6.15	Grocery Stores	48.19	3.77
Ford Motor Company	79.08	2.66	Automobiles	43.50	27.51
American Airlines Group	93.30	−0.57	Airlines	59.84	1.46

Notes:
[a]Long-term debt ratios are calculated as a percentage of total capital, where total capital is defined as long-term debt plus equity with both measured at book value. Note that this measure of the debt ratio does not include short-term debt.

Source: *MSN Money* (money.msn.com), May 29, 2014.

[35]Information on capital structures and financial strength is available from a multitude of sources. We used *MSN Money* (money.msn.com) to develop Table 14.5, but published sources include *The Value Line Investment Survey*, *Risk Management Association Annual Statement Studies*, and *Dun & Bradstreet Key Business Ratios*.

SELF TEST

Why do wide variations in the use of financial leverage occur across industries and among individual firms in each industry?

TYING IT ALL TOGETHER

When we studied the cost of capital in Chapter 10, we took the firm's capital structure as given and calculated the cost of capital based on that structure. Then in Chapters 11, 12, and 13, we described capital budgeting techniques, which use the cost of capital as input. Capital budgeting decisions determine the types of projects that a firm accepts, which affect the nature of the firm's assets and its business risk. In this chapter, we reverse the process, taking the firm's assets and business risk as given and then seeking to determine the best way to finance those assets. More specifically, in this chapter, we examined the effects of financial leverage on earnings per share, stock prices, and the cost of capital and we discussed various capital structure theories.

The different theories lead to different conclusions about the optimal capital structure, and no one has been able to prove that one theory is better than the others. Therefore, we cannot estimate a firm's optimal capital structure with much precision. Accordingly, financial executives generally treat the optimal capital structure as a range—for example, 40% to 50% debt—rather than as a precise point, such as 45% debt. The concepts discussed in this chapter are used as a guide, and they help managers understand the factors to consider when they are setting the target capital structures of their firms.

SELF-TEST QUESTIONS AND PROBLEMS

(Solutions Appear in Appendix A)

ST-1 **KEY TERMS** Define each of the following terms:

a. Capital; capital structure; optimal capital structure
b. Business risk; financial risk
c. Financial leverage; operating leverage; operating breakeven
d. Hamada equation; unlevered beta
e. Symmetric information; asymmetric information
f. Modigliani–Miller theories
g. Trade-off theory; signaling theory
h. Reserve borrowing capacity; pecking order
i. Windows of opportunity; net debt

ST-2 OPERATING LEVERAGE AND BREAK-EVEN ANALYSIS Olinde Electronics Inc. produces stereo components that sell at P = $100 per unit. Olinde's fixed costs are $200,000, variable costs are $50 per unit, 5,000 components are produced and sold each year, EBIT is currently $50,000, and Olinde's assets (all equity-financed) are $500,000. Olinde can change its production process by adding $400,000 to assets and $50,000 to fixed operating costs. This change would (1) reduce variable costs per unit by $10 and (2) increase output by 2,000 units, but (3) the sales price on all units would have to be lowered to $95 to permit sales of the additional output. Olinde has tax loss carry-forwards that cause its tax rate to be zero; it uses no debt; and its average cost of capital is 10%.

a. Should Olinde make the change? Why or why not?

b. Would Olinde's break-even point increase or decrease if it made the change?

c. Suppose Olinde was unable to raise additional equity financing and had to borrow the $400,000 at an interest rate of 10% to make the investment. Use the DuPont equation to find the expected ROA of the investment. Should Olinde make the change if debt financing must be used? Explain.

ST-3 OPTIMAL CAPITAL STRUCTURE Carlisle Industries is trying to determine its optimal capital structure, which now consists of only common equity. The firm will add debt to its capital structure if it minimizes its WACC, but the firm has no plans to use preferred stock in its capital structure. In addition, the firm's size will remain the same, so funds obtained from debt issued will be used to repurchase stock. The percentage of shares repurchased will be equal to the percentage of debt added to the firm's capital structure. (In other words, if the firm's debt-to-capital ratio increases from 0 to 25%, then 25% of the shares outstanding will be repurchased.)

Its treasury staff has consulted with investment bankers. On the basis of those discussions, the staff has created the following table showing the firm's debt cost at different debt levels:

Debt-to-Capital Ratio (w_d)	Equity-to-Capital Ratio (w_c)	Debt-to-Equity Ratio (D/E)	Bond Rating	Before-Tax Cost of Debt (r_d)
0.00	1.00	0.0000	AA	5.0%
0.25	0.75	0.3333	A	6.0
0.50	0.50	1.0000	BBB	8.3
0.75	0.25	3.0000	BB	11.0

The firm has total capital of $5 million and 200,000 shares of common stock outstanding. Its EBIT is $500,000 and will not change if debt, at any of the levels shown in the table above, is added to the firm's capital structure. Carlisle uses the CAPM to estimate its cost of common equity, r_s. It estimates that the risk-free rate is 3.5%, the market risk premium is 4.5%, and its tax rate is 35%. Carlisle's current beta, which is b_U because it has no debt, is 1.25.

a. Calculate the firm's interest expense, net income, shares outstanding, and EPS for each of the capital structures shown in the table above.

b. At what capital structure is EPS maximized, and what is the firm's EPS at this capital structure?

c. Calculate the after-tax cost of debt [$r_d(1 - T)$], beta (b_L), cost of equity (r_s), and WACC for each of the capital structures shown in the table above.

d. Considering only the capital structures shown, at what capital structure is WACC minimized and what is the WACC at this capital structure?

e. At what capital structure does the firm maximize shareholder value? Is this the same capital structure selected in parts b and d? Explain why it is, or why it isn't the same.

f. As an analyst, what is your recommendation to the firm's management regarding Carlisle's capital structure?

QUESTIONS

14-1 Changes in sales cause changes in profits. Would the profit change associated with sales changes be larger or smaller if a firm increased its operating leverage? Explain your answer.

14-2 Would each of the following increase, decrease, or have an indeterminant effect on a firm's break-even point (unit sales)?

a. The sales price increases with no change in unit costs.
b. An increase in fixed costs is accompanied by a decrease in variable costs.
c. A new firm decides to use MACRS depreciation for both book and tax purposes rather than the straight-line depreciation method.
d. Variable labor costs decline; other things are held constant.

14-3 Discuss the following statement: All else equal, firms with relatively stable sales are able to carry relatively high debt ratios. Is the statement true or false? Why?

14-4 If Congress increased the personal tax rate on interest, dividends, and capital gains but simultaneously reduced the rate on corporate income, what effect would this have on the average company's capital structure?

14-5 Which of the following would likely encourage a firm to increase the debt in its capital structure?

a. The corporate tax rate increases.
b. The personal tax rate increases.
c. Due to market changes, the firm's assets become less liquid.
d. Changes in the bankruptcy code make bankruptcy less costly to the firm.
e. The firm's sales and earnings become more volatile.

14-6 Why do public utilities generally use different capital structures than biotechnology companies?

14-7 Why is EBIT generally considered independent of financial leverage? Why might EBIT actually be affected by financial leverage at high debt levels?

14-8 Is the debt level that maximizes a firm's expected EPS the same as the debt level that maximizes its stock price? Explain.

14-9 If a firm goes from zero debt to successively higher levels of debt, why would you expect its stock price to rise first, then hit a peak, and then begin to decline?

14-10 When the Bell System was broken up, the old AT&T was split into a new AT&T and seven regional telephone companies. The specific reason for forcing the breakup was to increase the degree of competition in the telephone industry. AT&T had a monopoly on local service, long distance, and the manufacture of all equipment used by telephone companies; and the breakup was expected to open most of those markets to competition. In the court order that set the terms of the breakup, the capital structures of the surviving companies were specified and much attention was given to the increased competition telephone companies could expect in the future. Do you think the optimal capital structure after the breakup was the same as the pre-breakup optimal capital structure? Explain your position.

14-11 A firm is about to double its assets to serve its rapidly growing market. It must choose between a highly automated production process and a less automated one. It also must choose a capital structure for financing the expansion. Should the asset investment and financing decisions be jointly determined, or should each decision be made separately? How would these decisions affect one another? How could the leverage concept be used to help management analyze the situation?

PROBLEMS

Easy Problems 1–5

14-1 BREAK-EVEN ANALYSIS A company's fixed operating costs are $500,000, its variable costs are $3.00 per unit, and the product's sales price is $4.00. What is the company's break-even point; that is, at what unit sales volume will its income equal its costs?

14-2 OPTIMAL CAPITAL STRUCTURE Jackson Trucking Company is in the process of setting its target capital structure. The CFO believes that the optimal debt-to-capital ratio is somewhere between 20% and 50%, and her staff has compiled the following projections for EPS and the stock price at various debt levels:

Debt/Capital Ratio	Projected EPS	Projected Stock Price
20%	$3.20	$35.00
30	3.45	36.50
40	3.75	36.25
50	3.50	35.50

Assuming that the firm uses only debt and common equity, what is Jackson's optimal capital structure? At what debt-to-capital ratio is the company's WACC minimized?

14-3 RISK ANALYSIS

a. Given the following information, calculate the expected value for Firm C's EPS. Data for Firms A and B are as follows: $E(EPS_A) = \$5.10$, $\sigma_A = \$3.61$, $E(EPS_B) = \$4.20$, and $\sigma_B = \$2.96$.

	Probability				
	0.1	0.2	0.4	0.2	0.1
Firm A: EPS_A	($1.50)	$1.80	$5.10	$8.40	$11.70
Firm B: EPS_B	(1.20)	1.50	4.20	6.90	9.60
Firm C: EPS_C	(2.40)	1.35	5.10	8.85	12.60

b. You are given that $\sigma_C = \$4.11$. Discuss the relative riskiness of the three firms' earnings.

14-4 UNLEVERED BETA Harley Motors has $10 million in assets, which were financed with $2 million of debt and $8 million in equity. Harley's beta is currently 1.2, and its tax rate is 40%. Use the Hamada equation to find Harley's unlevered beta, b_U.

14-5 FINANCIAL LEVERAGE EFFECTS Firms HL and LL are identical except for their financial leverage ratios and the interest rates they pay on debt. Each has $20 million in invested capital, has $4 million of EBIT, and is in the 40% federal-plus-state tax bracket. Firm HL, however, has a debt-to-capital ratio of 50% and pays 12% interest on its debt, whereas LL has a 30% debt-to-capital ratio and pays only 10% interest on its debt. Neither firm uses preferred stock in its capital structure.

a. Calculate the return on invested capital (ROIC) for each firm.
b. Calculate the return on equity (ROE) for each firm.
c. Observing that HL has a higher ROE, LL's treasurer is thinking of raising the debt-to-capital ratio from 30% to 60% even though that would increase LL's interest rate on all debt to 15%. Calculate the new ROE for LL.

Intermediate Problems 6–9

14-6 BREAK-EVEN ANALYSIS The Weaver Watch Company sells watches for $25, fixed costs are $140,000, and variable costs are $15 per watch.

a. What is the firm's gain or loss at sales of 8,000 watches? At 18,000 watches?
b. What is the break-even point? Illustrate by means of a chart.
c. What would happen to the break-even point if the selling price was raised to $31? What is the significance of this analysis?
d. What would happen to the break-even point if the selling price was raised to $31 but variable costs rose to $23 a unit?

14-7 FINANCIAL LEVERAGE EFFECTS The Neal Company wants to estimate next year's return on equity (ROE) under different financial leverage ratios. Neal's total capital is $14 million, it currently uses only common equity, it has no future plans to use preferred stock in its

capital structure, and its federal-plus-state tax rate is 40%. The CFO has estimated next year's EBIT for three possible states of the world: $4.2 million with a 0.2 probability, $2.8 million with a 0.5 probability, and $700,000 with a 0.3 probability. Calculate Neal's expected ROE, standard deviation, and coefficient of variation for each of the following debt-to-capital ratios; then evaluate the results:

Debt/Capital Ratio	Interest Rate
0%	—
10	9%
50	11
60	14

14-8 **HAMADA EQUATION** Cyclone Software Co. is trying to establish its optimal capital structure. Its current capital structure consists of 25% debt and 75% equity; however, the CEO believes that the firm should use more debt. The risk-free rate, r_{RF}, is 5%; the market risk premium, RP_M, is 6%; and the firm's tax rate is 40%. Currently, Cyclone's cost of equity is 14%, which is determined by the CAPM. What would be Cyclone's estimated cost of equity if it changed its capital structure to 50% debt and 50% equity?

14-9 **RECAPITALIZATION** Tapley Inc. currently has total capital equal to $5 million, has zero debt, is in the 40% federal-plus-state tax bracket, has a net income of $1 million, and distributes 40% of its earnings as dividends. Net income is expected to grow at a constant rate of 5% per year, 200,000 shares of stock are outstanding, and the current WACC is 13.40%.

The company is considering a recapitalization where it will issue $1 million in debt and use the proceeds to repurchase stock. Investment bankers have estimated that if the company goes through with the recapitalization, its before-tax cost of debt will be 11% and its cost of equity will rise to 14.5%.

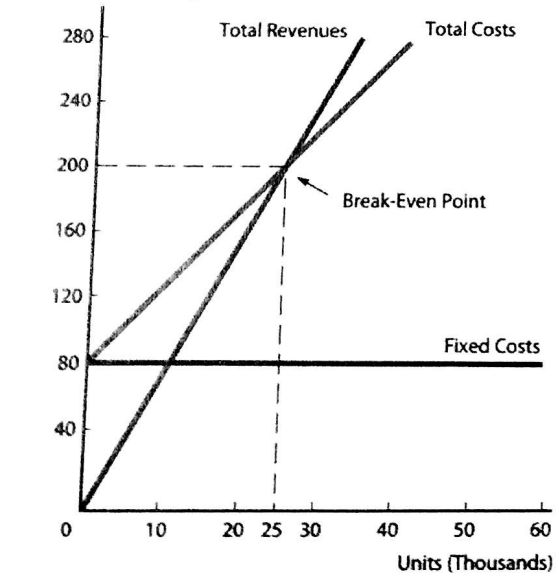
a. What is the stock's current price per share (before the recapitalization)?
b. Assuming that the company maintains the same payout ratio, what will be its stock price following the recapitalization? Assume that shares are repurchased at the price calculated in part a.

Challenging Problems 10–13

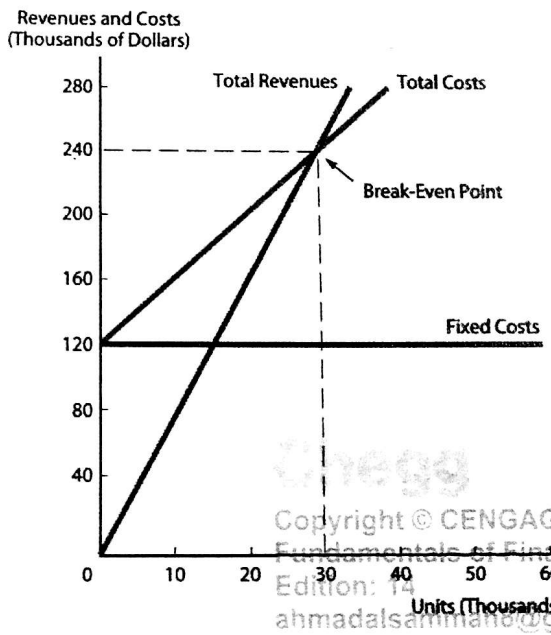
14-10 **BREAKEVEN AND OPERATING LEVERAGE**

a. Given the following graphs, calculate the total fixed costs, variable costs per unit, and sales price for Firm A. Firm B's fixed costs are $120,000, its variable costs per unit are $4, and its sales price is $8 per unit.
b. Which firm has the higher operating leverage at any given level of sales? Explain.
c. At what sales level, in units, do both firms earn the same operating profit?

Firm A



Firm B



14-11 RECAPITALIZATION Currently, Bloom Flowers Inc. has a capital structure consisting of 20% debt and 80% equity. Bloom's debt currently has an 8% yield to maturity. The risk-free rate (r_{RF}) is 5%, and the market risk premium ($r_M - r_{RF}$) is 6%. Using the CAPM, Bloom estimates that its cost of equity is currently 12.5%. The company has a 40% tax rate.

a. What is Bloom's current WACC?

b. What is the current beta on Bloom's common stock?

c. What would Bloom's beta be if the company had no debt in its capital structure? (That is, what is Bloom's unlevered beta, b_U?)

Bloom's financial staff is considering changing its capital structure to 40% debt and 60% equity. If the company went ahead with the proposed change, the yield to maturity on the company's bonds would rise to 9.5%. The proposed change will have no effect on the company's tax rate.

d. What would be the company's new cost of equity if it adopted the proposed change in capital structure?

e. What would be the company's new WACC if it adopted the proposed change in capital structure?

f. Based on your answer to part e, would you advise Bloom to adopt the proposed change in capital structure? Explain.

14-12 BREAKEVEN AND LEVERAGE Wingler Communications Corporation (WCC) produces premium stereo headphones that sell for $28.80 per set, and this year's sales are expected to be 450,000 units. Variable production costs for the expected sales under present production methods are estimated at $10,200,000, and fixed production (operating) costs at present are $1,560,000. WCC has $4,800,000 of debt outstanding at an interest rate of 8%. There are 240,000 shares of common stock outstanding, and there is no preferred stock. The dividend payout ratio is 70%, and WCC is in the 40% federal-plus-state tax bracket.

The company is considering investing $7,200,000 in new equipment. Sales would not increase, but variable costs per unit would decline by 20%. Also, fixed operating costs would increase from $1,560,000 to $1,800,000. WCC could raise the required capital by borrowing $7,200,000 at 10% or by selling 240,000 additional shares of common stock at $30 per share.

a. What would be WCC's EPS (1) under the old production process, (2) under the new process if it uses debt, and (3) under the new process if it uses common stock?

b. At what unit sales level would WCC have the same EPS assuming it undertakes the investment and finances it with debt or with stock? [Hint: V = variable cost per unit = $8,160,000/450,000, and $EPS = [(PQ - VQ - F - I)(1 - T)]/N$. Set $EPS_{Stock} = EPS_{Debt}$ and solve for Q.]

c. At what unit sales level would EPS = 0 under the three production/financing setups—that is, under the old plan, the new plan with debt financing, and the new plan with stock financing? (Hint: Note that V_{old} = $10,200,000/450,000, and use the hints for part b, setting the EPS equation equal to zero.)

d. On the basis of the analysis in parts a through c, and given that operating leverage is lower under the new setup, which plan is the riskiest, which has the highest expected EPS, and which would you recommend? Assume that there is a fairly high probability of sales falling as low as 250,000 units. Determine EPS_{Debt} and EPS_{Stock} at that sales level to help assess the riskiness of the two financing plans.

14-13 FINANCING ALTERNATIVES The Severn Company plans to raise a net amount of $270 million to finance new equipment in early 2016. Two alternatives are being considered: Common stock may be sold to net $60 per share, or bonds yielding 12% may be issued. The balance sheet and income statement of the Severn Company prior to financing are as follows:

The Severn Company: Balance Sheet as of December 31, 2015 (Millions of Dollars)

Current assets	$ 900.00	Notes payable	$ 255.00
Net fixed assets	450.00	Long-term debt (10%)	697.50
		Common stock, $3 par	60.00
		Retained earnings	337.50
Total assets	$1,350.00	Total liabilities and equity	$1,350.00

The Severn Company: Income Statement for Year Ended December 31, 2015 (Millions of Dollars)

Sales	$2,475.00
Operating costs	2,227.50
Earnings before interest and taxes (10%)	$ 247.50
Interest on short-term debt	15.00
Interest on long-term debt	69.75
Earnings before taxes	$ 162.75
Federal-plus-state taxes (40%)	65.10
Net income	$ 97.65

The probability distribution for annual sales is as follows:

Probability	Annual Sales (Millions of Dollars)
0.30	$2,250
0.40	2,700
0.30	3,150

Assuming that EBIT equals 10% of sales, calculate earnings per share (EPS) under the debt financing and the stock financing alternatives at each possible sales level. Then calculate expected EPS and σ_{EPS} under both debt and stock financing alternatives. Also calculate the debt-to-capital ratio and the times-interest-earned (TIE) ratio at the expected sales level under each alternative. The old debt will remain outstanding. Which financing method do you recommend? [Hint: Notes payable should be included in both the numerator and the denominator of the debt-to-capital ratio.]

Comprehensive/Spreadsheet Problem

14-14 WACC AND OPTIMAL CAPITAL STRUCTURE Elliott Athletics is trying to determine its optimal capital structure, which now consists of only debt and common equity. The firm does not currently use preferred stock in its capital structure, and it does not plan to do so in the future. Its treasury staff has consulted with investment bankers. On the basis of those discussions, the staff has created the following table showing the firm's debt cost at different debt levels:

Debt-to-Capital Ratio (w_d)	Equity-to-Capital Ratio (w_c)	Debt-to-Equity Ratio (D/E)	Bond Rating	Before-Tax Cost of Debt (r_d)
0.0	1.0	0.00	A	7.0%
0.2	0.8	0.25	BBB	8.0
0.4	0.6	0.67	BB	10.0
0.6	0.4	1.50	C	12.0
0.8	0.2	4.00	D	15.0

Elliott uses the CAPM to estimate its cost of common equity, r_s, and estimates that the risk-free rate is 5%, the market risk premium is 6%, and its tax rate is 40%. Elliott estimates that if it had no debt, its "unlevered" beta, b_U, would be 1.2.

a. What is the firm's optimal capital structure, and what would be its WACC at the optimal capital structure?

b. If Elliott's managers anticipate that the company's business risk will increase in the future, what effect would this likely have on the firm's target capital structure?

c. If Congress were to dramatically increase the corporate tax rate, what effect would this likely have on Elliott's target capital structure?

d. Plot a graph of the after-tax cost of debt, the cost of equity, and the WACC versus (1) the debt/capital ratio and (2) the debt/equity ratio.