15-5a Empirical Evidence[19]

There have been hundreds, perhaps even thousands, of papers testing the capital structure theories described in the previous section. We can cover only the highlights here, beginning with the empirical evidence.[20]

THE TRADE-OFF BETWEEN TAX BENEFITS AND BANKRUPTCY COSTS

Recent studies by Professors Van Binsbergen, Graham, and Yang and by Professor Korteweg suggest that the average net benefits of leverage (i.e., the value of the tax shield less the expected cost of financial distress) make up about 3% to 6% of a levered firm's value.[21] To put this into perspective, let's look at the impact of debt on an average company's value. The average company is financed with about 25% to 35% debt, so let's suppose that the company has $25 of debt and $75 of equity, just to keep the arithmetic simple. The total net benefit of debt is about $5, based on the recent research. This implies that each dollar of debt added (on average) about $0.20 of value ($5/$25 = 0.2) to the company. The first dollar of debt adds a bigger net benefit because bankruptcy risk is low when debt is low. By the time the 25th dollar of debt is added, its incremental net benefit is close to zero—the incremental expected costs of financial distress are about equal to the incremental expected tax shield.

These studies also showed that the net benefits of debt increase slowly until reaching the optimal level but decline rapidly thereafter. In other words, it isn't very costly to be somewhat below the optimal level of debt, but it is costly to exceed it.

A particularly interesting study by Professors Mehotra, Mikkelson, and Partch examined the capital structure of firms that were spun off from their parent companies.[22] The financing choices of existing firms might be influenced by their past financing choices and by the costs of moving from one capital structure to another, but because spin-offs are newly created companies, managers can choose a capital structure without regard to these issues. The study found that more profitable firms (which have a lower expected probability of bankruptcy) and more asset-intensive firms (which have better collateral and thus a lower cost of bankruptcy should one occur) have higher levels of debt.

The Miller model hypothesizes that the value of a levered firm is affected by personal tax rates as well as corporate tax rates. Therefore, a cut in the tax rate on dividends should reduce the value of leverage, all else held equal. Professors Lin and Flannery examined the 2003 tax cut on dividends and found that leverage decreases as the personal effective tax rate on stock decreases, which is consistent with the Miller model's prediction. In addition, the impact of the tax cut was more pronounced for companies with a high proportion of individual owners (who are subject to personal income tax) than for companies with a high proportion of institutional owners (such as pension funds that might not be liable for personal taxes).[23]

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[19]All of the empirical results described in this section are based on market values of leverage, not book values.

[20]This section also draws heavily from Barclay and Smith, "The Capital Structure Puzzle," cited in footnote 17; Jay Ritter, ed., *Recent Developments in Corporate Finance* (Northampton, MA: Edward Elgar Publishing Inc., 2005); and a presentation by Jay Ritter at the 2003 FMA meeting, "The Windows of Opportunity Theory of Capital Structure."

[21]See Jules H. Van Binsbergen, John H. Graham, and Jie Yang, "The Cost of Debt," *Journal of Finance*, Vol. 65, No. 6, December 2010, pp. 2089–2135; also see Arthur Korteweg, "The Net Benefits to Leverage," *Journal of Finance*, Vol. 65, No. 6, December 2010, pp. 2137–2169.

[22]See V. Mehotra, W. Mikkelson, and M. Partch, "The Design of Financial Policies in Corporate Spin-Offs," *Review of Financial Studies*, Winter 2003, pp. 1359–1388.

[23]See L. Lin and M. J. Flannery, "Do Personal Taxes Affect Capital Structure? Evidence from the 2003 Tax Cut," *Journal of Financial Economics*, Vol. 109, 2013, pp. 549–565.

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The empirical evidence clearly shows that corporate taxes, personal taxes, and bankruptcy costs matter when it comes to choosing a capital structure. In particular, companies do consider the trade-off between tax benefits and bankruptcy costs.

A DYNAMIC TRADE-OFF THEORY

However, there is also evidence that is inconsistent with the static optimal target capital structure implied by the trade-off theory. For example, stock prices are volatile, which frequently causes a firm's actual market-based debt ratio to deviate from its target. However, such deviations don't cause firms to immediately return to their target by issuing or repurchasing securities. Instead, Professors Flannery and Rangan show that firms tend to make a partial adjustment each year, moving about 30% of the way toward their target capital structure. In a more recent study, Professors Faulkender, Flannery, Hankins, and Smith show that the speed of adjustment depends on a company's cash flows—companies with high cash flows adjust by about 50%. This effect is even more pronounced if the company's leverage exceeds its target—high cash flow companies in this situation have a 70% speed of adjustment. This is consistent with the idea that it is more costly to exceed the target debt ratio than to be lower than the target.[24]

MARKET TIMING

As we mentioned in Chapter 14, companies with infrequent stock repurchase activity are able to repurchase stock at a lower average price than the average price in the months surrounding the repurchase, indicating ability to time the market with respect to repurchases. This supports the idea that a firm's managers have better information than investors regarding their stock's value, implying that managers would issue stock when it is overvalued. We see evidence of this when a company has had a big stock run-up. This reduces the market-based leverage ratio, so the trade-off theory suggests that the firm should issue debt to return to its target. However, firms tend to do the opposite, issuing stock after big run-ups. This is much more consistent with the market timing theory, with managers trying to time the market by issuing stock when they perceive the market to be overvalued.

Furthermore, firms tend to issue debt when stock prices and interest rates are low. The maturity of the issued debt seems to reflect an attempt to time interest rates: Firms tend to issue short-term debt if the term structure is upward sloping but long-term debt if the term structure is flat. Again, these facts suggest that managers try to time the market.

SIGNALING AND THE PECKING ORDER

When a firm announces a seasoned equity offering, the stock price tends to fall by around 2% to 4%, all else held equal, suggesting that investors believe that firms issue equity when it is overvalued.[25] For seasoned nonconvertible debt offerings, the stock price tends to fall a little, but not by a significant amount.[26] Asymmetric information is a significant problem in stock and bond issues, but is less likely when a company announces a large

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[24]See Mark Flannery and Kasturi Rangan, "Partial Adjustment toward Target Capital Structures," *Journal of Financial Economics,* Vol. 79, 2006, pp. 469–506. Also see Michael Faulkender, Mark Flannery, Kristine Hankins, and Jason Smith, "Cash Flows and Leverage," *Journal of Financial Economics,* Vol. 103, 2012, pp. 632–646.

[25]For the first studies to document this phenomenon, see W. Mikkelson and M. Partch, "Valuation Effects of Security Offerings and the Issuance Process," *Journal of Financial Economics,* Vol. 15, 1986, pp. 31–60, and R. Masulis and A. Korwar, "Seasoned Equity Offerings," *Journal of Financial Economics,* Vol. 15, 1986, pp. 91–118.

[26]See B. E. Eckbo, "Valuation Effects of Corporate Debt Offerings," *Journal of Financial Economics,* Vol. 15, 1986, pp. 119–151.

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credit agreement with a bank—in fact, the stock price reaction is positive.[27] These results suggest that signaling is important, especially when informational asymmetry is high.

Given these results, it is no surprise that firms issue equity much less frequently than debt. On the surface, this seems to support both the pecking order hypothesis and the signaling hypothesis. The pecking order hypothesis predicts that firms with a high level of informational asymmetry, which causes equity issuances to be costly, should issue debt before issuing equity. Yet we often see the opposite, with high-growth firms (which usually have greater informational asymmetry) issuing more equity than debt. Also, many highly profitable firms could afford to issue debt (which comes before equity in the pecking order) but instead choose to issue equity. With respect to the signaling hypothesis, consider the case of firms that have large increases in earnings that were unanticipated by the market. If managers have superior information, then they will anticipate these upcoming performance improvements and issue debt before the increase. Such firms do, in fact, tend to issue debt slightly more frequently than other firms, but the difference isn't economically meaningful.

RESERVE BORROWING CAPACITY

Many firms have less debt than might be expected, and many have large amounts of short-term investments. This is especially true for firms with high market/book ratios (which indicate many growth options as well as informational asymmetry). This behavior is consistent with the hypothesis that investment opportunities influence attempts to maintain reserve borrowing capacity. It is also consistent with tax considerations, because low-growth firms (which have more debt) are more likely to benefit from the tax shield. This behavior is not consistent with the pecking order hypothesis, where low-growth firms (which often have high free cash flow) would be able to avoid issuing debt by raising funds internally.

SUMMARY OF EMPIRICAL TESTS

To summarize these results, it appears that firms try to capture debt's tax benefits while avoiding financial distress costs. However, they also allow their debt ratios to deviate from the static optimal target ratio implied by the trade-off theory. In fact, Professors Harry DeAngelo, Linda DeAngelo, and Toni Whited extend the dynamic trade-off model by showing that firms often deliberately issue debt to take advantage of unexpected investment opportunities, even if this causes them to exceed their target debt ratio.[28] Firms often maintain reserve borrowing capacity, especially firms with many growth opportunities or problems with informational asymmetry.[29] There is a little evidence indicating that firms follow a pecking order and use security issuances as signals, but there is some evidence in support of the market timing theory.

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[27]As the old saying goes, "If you borrow $1,000, you have a banker; if you borrow $10 million, you have a partner." See C. James, "Some Evidence on the Uniqueness of Bank Loans," *Journal of Financial Economics,* Vol. 19, 1987, pp. 217–235.

[28]See Harry DeAngelo, Linda DeAngelo, and Toni Whited, "Capital Structure Dynamics and Transitory Debt," *Journal of Financial Economics,* Vol. 99, 2011, pp. 235–261.

[29]For more on empirical tests of capital structure theory, see Gregor Andrade and Steven Kaplan, "How Costly Is Financial (Not Economic) Distress? Evidence from Highly Leveraged Transactions That Became Distressed," *Journal of Finance,* Vol. 53, 1998, pp. 1443–1493; Malcolm Baker, Robin Greenwood, and Jeffrey Wurgler, "The Maturity of Debt Issues and Predictable Variation in Bond Returns," *Journal of Financial Economics,* November 2003, pp. 261–291; Murray Z. Frank and Vidhan K. Goyal, "Testing the Pecking Order Theory of Capital Structure," *Journal of Financial Economics,* February 2003, pp. 217–248; and Michael Long and Ileen Malitz, "The Investment-Financing Nexus: Some Empirical Evidence," *Midland Corporate Finance Journal,* Fall 1985, pp. 53–59.

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15-5b Implications for Managers

Managers should explicitly consider tax benefits when making capital structure decisions. Tax benefits obviously are more valuable for firms with high tax rates. Firms can utilize tax loss carryforwards and carrybacks, but the time value of money means that tax benefits are more valuable for firms with stable, positive pre-tax income. Therefore, a firm whose sales are relatively stable can safely take on more debt and incur higher fixed charges than a company with volatile sales. Other things being equal, a firm with less operating leverage is better able to employ financial leverage because it will have less business risk and less volatile earnings.

Managers should also consider the expected cost of financial distress, which depends on the probability and cost of distress. Notice that stable sales and lower operating leverage provide tax benefits but also reduce the *probability* of financial distress. One *cost* of financial distress comes from lost investment opportunities. Firms with profitable investment opportunities need to be able to fund them, either by holding higher levels of marketable securities or by maintaining excess borrowing capacity.

Another cost of financial distress is the possibility of being forced to sell assets to meet liquidity needs. General-purpose assets that can be used by many businesses are relatively liquid and make good collateral, in contrast to special-purpose assets. Thus, real estate companies are usually highly leveraged, whereas companies involved in technological research are not.

Asymmetric information also has a bearing on capital structure decisions. For example, suppose a firm has just successfully completed an R&D program, and it forecasts higher earnings in the immediate future. However, the new earnings are not yet anticipated by investors and hence are not reflected in the stock price. This company should not issue stock—it should finance with debt until the higher earnings materialize and are reflected in the stock price. Then it could issue common stock, retire the debt, and return to its target capital structure.

Managers should consider conditions in the stock and bond markets. For example, during a recent credit crunch, the junk bond market dried up and there was simply 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 bonds to get their capital structures back on target.

Finally, managers should always consider lenders' and rating agencies' attitudes. For example, Moody's and Standard & Poor's told a large utility that its bonds would be downgraded if it issued more debt. This influenced the utility's decision to finance its expansion with common equity. This doesn't mean that managers should never increase debt if it will cause their bond rating to fall, but managers should always factor this into their decision making.[30]

SELF-TEST

Which capital structure theories does the empirical evidence seem to support?

What issues should managers consider when making capital structure decisions?

[30]For some insights into how practicing financial managers view the capital structure decision, see John Graham and Campbell Harvey, "The Theory and Practice of Corporate Finance: Evidence from the Field," *Journal of Financial Economics*, Vol. 60, 2001, pp. 187–243; Ravindra R. Kamath, "Long-Term Financing Decisions: Views and Practices of Financial Managers of NYSE Firms," *Financial Review*, May 1997, pp. 331–356; and Edgar Norton, "Factors Affecting Capital Structure Decisions," *Financial Review*, August 1991, pp. 431–446.

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15-6 Estimating the Optimal Capital Structure

Managers should choose the capital structure that maximizes shareholders' wealth. The basic approach is to consider a trial capital structure, based on the market values of the debt and equity, and then estimate the wealth of the shareholders under this capital structure. This approach should be repeated until an optimal capital structure is identified. There are several steps in the analysis of each potential capital structure: (1) Estimate the interest rate the firm will pay. (2) Estimate the cost of equity. (3) Estimate the weighted average cost of capital. (4) Estimate the value of operations, which is the present value of free cash flows discounted by the new WACC. The objective is to find the amount of debt financing that maximizes the value of operations. As we will show, this capital structure maximizes both shareholder wealth and the intrinsic stock price. The following sections explain each of these steps, using the company we considered earlier, Strasburg Electronics.

15-6a Strasburg's Current Value and Capital Structure

In Section 15-2, Strasburg was examining several different capital structure plans. Strasburg implemented Plan L, the one with high operating leverage and \$50 million in debt financing. The plan has been in place for a year, and Strasburg's stock price is now \$20 per share. With 10 million shares, Strasburg's market value of equity is \$20(10) = \$200 million. Strasburg has no short-term investments, so Strasburg's total enterprise value is the sum of its debt and equity: V = \$50 + \$200 = \$250 million. In terms of market values, Strasburg's capital structure has 20% debt (w_d = \$50/\$250 = 0.20) and 80% equity (w_s = \$200/\$250 = 0.80). These calculations are reported in Figure 15-4 along with other input data.

Is this the optimal capital structure? We will address the question in more detail later, but for now let's focus on understanding Strasburg's current valuation, beginning with its cost of capital. Strasburg has a beta of 1.25. We can use the Capital Asset Pricing Model (CAPM) to estimate the cost of equity. The risk-free rate, r_{RF}, is 6.3% and the market risk premium, RP_M, is 6%, so the cost of equity is:

$$r_s = r_{RF} + b(RP_M) = 6.3\% + 1.25(6\%) = 13.8\%$$

The weighted average cost of capital is:

$$\begin{aligned} WACC &= w_d(1 - T)r_d + w_s r_s \\ &= 20\%(1 - 0.40)(8\%) + 80\%(13.8\%) \\ &= 12\% \end{aligned}$$

As shown previously in Figure 15-1, Plan L has a NOPAT of \$30 million. Strasburg expects zero growth, which means there are no required investments in capital. Therefore, FCF is equal to NOPAT, as shown in Figure 15-4. Using the constant growth formula, the value of operations is:

$$V_{op} = \frac{FCF(1 + g_L)}{WACC - g_L} = \frac{\$30(1 + 0)}{0.12 - 0} = \$250$$

Figure 15-4 illustrates the calculation of the intrinsic stock price. For Strasburg, the intrinsic stock price and the market price are each equal to \$20. Can Strasburg increase its value by changing its capital structure? The next sections answer that question.

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FIGURE 15-4
Strasburg's Current Value and Capital Structure (Millions of Dollars, Except for Per Share Data)

	A	B	C	D	E
98	**Input Data:**		**Capital Structure:**		
99	Tax rate	40.00%	Market value of equity (S = P x n)		$200
100	Debt (D)	$50.00	Total value (V = D + S)		$250
101	# of shares (n)	10.00	% financed with debt (w_d = D/V)		20%
102	Stock price (P)	$20.00	% financed with stock (w_s = S/V)		80%
103	NOPAT	$30.00			
104	Free Cash Flow (FCF)	$30.00			
105	Growth rate in FCF (g_L)	0.00%			
106	**Cost of Capital:**		**Estimated Intrinsic Value:**		
107	Cost of debt (r_d)	8.00%	Value of operations:		
108	Beta (b)	1.25	V_{op} = [FCF(1 + g_L)]/(WACC g_L)		$250.00
109	Risk-free rate (r_{RF})	6.30%	+ Value of ST investments		$0.00
110	Mkt. risk prem. (RP_M)	6.00%	Estimated total intrinsic value		$250.00
111	Cost of equity:		Debt		$50.00
112	$r_s = r_{RF} + b(RP_M)$	13.80%	Estimated intrinsic value of equity		$200.00
113	WACC	12.00%	÷ Number of shares		10.00
114			Estimated intrinsic price per share		$20.00

Source: See the file ***Ch15 Tool Kit.xlsx***. Numbers are reported as rounded values for clarity, but are calculated using *Excel*'s full precision. Thus, intermediate calculations using the figure's rounded values will be inexact.

Note: Strasburg's sales, earnings, and assets are not growing, so it does not need investments in operating capital. Therefore, FCF = NOPAT(1 – T). The growth in FCF also is zero.

15-6b Estimating the Weighted Average Cost of Capital (WACC) for Different Levels of Debt

Following is a description of the steps to estimate the weighted average cost of capital for different levels of debt.

ESTIMATING THE COST OF DEBT (r_d)

The CFO asked Strasburg's investment bankers to estimate the cost of debt at different capital structures. The investment bankers began by analyzing industry conditions and prospects. They appraised Strasburg's business risk based on its past financial statements and its current technology and customer base. The bankers also forecasted financial statements with different capital structures and analyzed such key ratios as the current ratio and the times-interest-earned ratio. Finally, they factored in current conditions in the financial markets, including interest rates paid by firms in Strasburg's industry. Based on their analysis and judgment, they estimated interest rates at various capital structures as shown in Row 2 of Figure 15-5, starting with a 7.7% cost of debt.[31]

[31]For a description of a technique for estimating the cost of debt, see Jules H. Van Binsbergen, John H. Graham, and Jie Yang, "An Empirical Model of Optimal Capital Structure," *Journal of Applied Corporate Finance*, Vol. 23, No. 4, Fall, 2011, pp. 34–59. They also provide an approach for estimating the optimal capital structure that explicitly incorporates the tax benefits of debt net of the financial distress costs and other costs.

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FIGURE 15-5
Estimating Strasburg's Optimal Capital Structure (Millions of Dollars)

	A	B	C	D	E	F	G	H
131		Percent of Firm Financed with Debt (w_d)						
132		0%	10%	20%	30%	40%	50%	60%
133	1. w_s	100.00%	90.00%	80.00%	70.00%	60.00%	50.00%	40.00%
134	2. r_d	7.70%	7.80%	8.00%	8.50%	9.90%	12.00%	16.00%
135	3. b	1.09	1.16	1.25	1.37	1.52	1.74	2.07
136	4. r_s	12.82%	13.26%	13.80%	14.50%	15.43%	16.73%	18.69%
137	5. $r_d(1 - T)$	4.62%	4.68%	4.80%	5.10%	5.94%	7.20%	9.60%
138	6. WACC	12.82%	12.40%	12.00%	11.68%	11.63%	11.97%	13.24%
139	7. V_{op}	$233.98	$241.96	$250.00	$256.87	$257.86	$250.68	$226.65
140	8. Debt	$0.00	$24.20	$50.00	$77.06	$103.14	$125.34	$135.99
141	9. Equity	$233.98	$217.76	$200.00	$179.81	$154.72	$125.34	$90.66
142	10. # Shares	12.72	11.34	10.00	8.69	7.44	6.25	5.13
143	11. Stock price	$18.40	$19.20	$20.00	$20.69	$20.79	$20.07	$17.66
144	12. Net income	$30.00	$28.87	$27.60	$26.07	$23.87	$20.98	$16.95
145	13. EPS	$2.36	$2.54	$2.76	$3.00	$3.21	$3.36	$3.30

Source: See the file ***Ch15 Tool Kit.xlsx***. Numbers are reported as rounded values for clarity, but are calculated using *Excel*'s full precision. Thus, intermediate calculations using the figure's rounded values will be inexact.

Notes:

1. The percent financed with equity is $w_s = 1 - w_d$.
2. The interest rate on debt, r_d, is obtained from investment bankers. This is the resulting average rate on all debt, not the marginal rate on new debt.
3. Beta is estimated using Hamada's formula, the unlevered beta of 1.09, and a tax rate of 40%: $b = b_U[1 + (1 - T)(w_d/w_s)]$.
4. The cost of equity is estimated using the CAPM formula with a risk-free rate of 6.3% and a market risk premium of 6%: $r_s = r_{RF} + b(RP_M)$.
5. The after-tax cost of debt is $r_d(1 - T)$, where T = 40%.
6. The weighted average cost of capital is calculated as $WACC = w_d r_d(1 - T) + w_s r_s$.
7. The value of the firm's operations is calculated as $V_{op} = [FCF(1 + g_L)]/(WACC - g_L)$, where FCF = $30 million and $g_L = 0$.
8. Debt $= w_d \times V_{op}$.
9. The intrinsic value of equity after the recapitalization and repurchase is $S_{Post} = V_{op} - \text{Debt} = w_s \times V_{op}$.
10. The number of shares after the recap has been completed is found using this equation: $n_{Post} = n_{Prior} \times [(V_{opNew} - D_{New})/(V_{opNew} - D_{Old})]$. The subscript "Old" indicates values from the original capital structure, where $w_d = 20\%$; the subscript "New" indicates values at the current capital structure after the recap and repurchase; and the subscript "Post" indicates values after the recap and repurchase.
11. The price after the recap and repurchase is $P_{Post} = S_{Post}/n_{Post}$, but we can also find the price as $P_{Post} = (V_{opNew} - D_{Old})n_{Prior}$.
12. EBIT is $50 million; see Figure 15-1. Net income is $NI = (EBIT - r_d D)(1 - T)$.
13. Earnings per share is $EPS = NI/n_{Post}$.

This rate increases to 16% if the firm finances 60% of its capital structure with debt. (*Note:* These are the average rates for all of Strasburg's possible debt levels, not the marginal rates for the next dollar of debt.) Strasburg's current situation is in Column D and is shown in blue. (We will explain all the rows in Figure 15-5 in the following discussion.)

ESTIMATING THE COST OF EQUITY (r_s) WITH THE HAMADA EQUATION

An increase in the debt ratio also increases the risk faced by shareholders, and this has an effect on the cost of equity, r_s. Recall from Chapter 6 that a stock's beta is the relevant measure of risk for diversified investors. Moreover, it has been demonstrated, both

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theoretically and empirically, that beta increases with financial leverage. The **Hamada equation** specifies the effect of financial leverage on beta:[32]

$$b = b_U[1 + (1 - T)(D/S)] \quad (15\text{-}11)$$

Here D is the market value of the debt and S is the market value of the equity. The Hamada equation shows how increases in the market value debt/equity ratio increase beta. Here b_U is the firm's **unlevered beta** coefficient—that is, the beta it would have if it had no debt. In that case, beta would depend entirely on business risk and thus be a measure of the firm's "basic business risk."

Sometimes it is more convenient to work with the percentages of debt and equity at which the firm is financed (w_d and w_s) rather than the dollar values of D and S. Notice that w_d and w_s are defined as $D/(D + S)$ and $S/(D + S)$, respectively. This means that the ratio w_d/w_s is equal to the ratio D/S. Substituting these values gives us another form of Hamada's formula:

$$b = b_U[1 + (1 - T)(w_d/w_s)] \quad (15\text{-}11a)$$

Often we know the current capital structure and beta but wish to know the unlevered beta. We find this by rearranging Equation 15-11a as follows:

$$b_U = b/[1 + (1 - T)(w_d/w_s)] \quad (15\text{-}12)$$

For Strasburg, the unlevered beta is:

$$\begin{aligned} b_U &= 1.25/[1 + (1 - 0.40)(0.20/0.80)] \\ &= 1.087 \end{aligned}$$

Using this unlevered beta, we can then apply Hamada's formula in Equation 15-11a to determine estimates of Strasburg's beta for different capital structures. These results are reported in Line 3 of Figure 15-5.

Recall from Section 15-6a that the risk-free rate is 6.3% and the market risk premium is 6%. We can use the CAPM and the previously estimated betas to estimate Strasburg's cost of equity for different capital structures (which cause Strasburg's beta to change). These results are shown in Line 4 of Figure 15-5. As expected, Strasburg's cost of equity increases as its debt increases. Figure 15-6 graphs Strasburg's required return on equity at different debt ratios. Observe that the cost of equity consists of the 6.3% risk-free rate, a constant premium for business risk in the amount of $RP_M(b_U) = 6.522\%$, and a premium for financial risk in the amount of $RP_M(b - b_U)$ that starts at zero (because $b = b_U$ for zero debt) but rises at an increasing rate as the debt ratio increases.

THE WEIGHTED AVERAGE COST OF CAPITAL AT DIFFERENT LEVELS OF DEBT

Line 6 of Figure 15-5 shows Strasburg's weighted average cost of capital, WACC, at different capital structures. As the debt ratio increases, the costs of both debt and equity

[32]See Robert S. Hamada, "Portfolio Analysis, Market Equilibrium, and Corporation Finance," *Journal of Finance,* March 1969, pp. 13–31. For a comprehensive framework, see Robert A. Taggart, Jr., "Consistent Valuation and Cost of Capital Expressions with Corporate and Personal Taxes," *Financial Management,* Autumn 1991, pp. 8–20.

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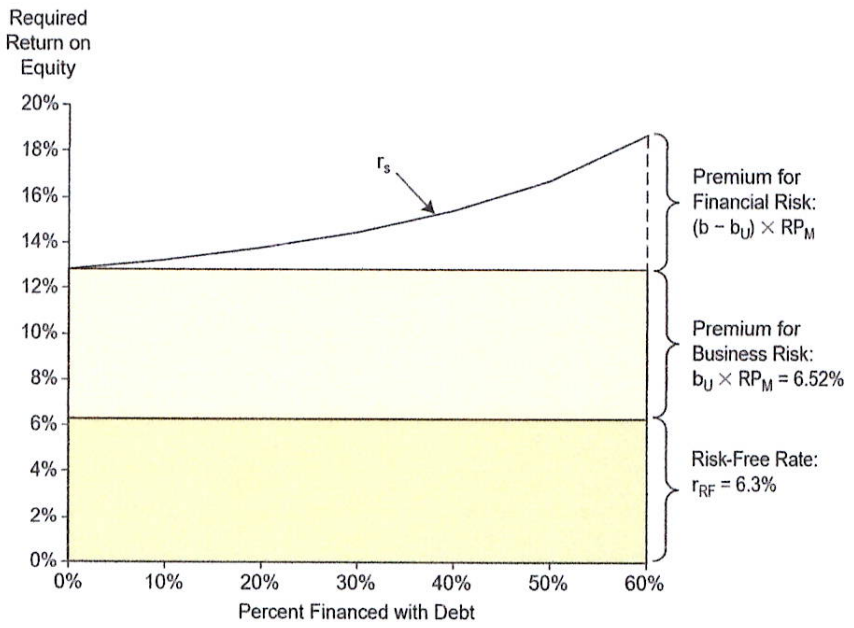
FIGURE 15-6
Strasburg's Required Rate of Return on Equity at Different Debt Levels



rise, at first slowly but then at an accelerating rate. Eventually, the increasing costs of these two components offset the fact that more debt (which is still less costly than equity) is being used. At 40% debt, Strasburg's WACC hits a minimum of 11.63%; Column F is shown in silver to indicate that it is the capital structure with the minimum WACC. Notice that the WACC begins to increase for capital structures with more than 40% debt. Figure 15-7 shows how the WACC changes as debt increases.

Also note that even though the component cost of equity is always higher than that of debt, only using debt would not maximize value. If Strasburg were to issue more than 40% debt, then the costs of both debt and equity would increase in such a way that the overall WACC would increase, because the cost of debt would increase by more than the cost of equity.

15-6c Estimating the Firm's Value

As we showed previously, Strasburg currently has a $250 million intrinsic value of operations: $w_d = 20\%$, WACC = 12%, FCF = $30 million, and zero growth in FCF. Using the same approach as in Section 15-6a, we can use the data in Figure 15-5 to estimate Strasburg's value of operations at different capital structures; these results are reported in Line 7 of Figure 15-5 and are graphed in Figure 15-8.[33] The maximum value of $257.86 million occurs at a capital structure with 40% debt, which also is the capital structure that minimizes the WACC.

[33]In this analysis we assume that Strasburg's expected EBIT and FCF are constant for the various capital structures. In a more refined analysis, we might try to estimate any possible declines in FCF at high levels of debt as the threat of bankruptcy becomes imminent.

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FIGURE 15-7
Effects of Capital Structure on the Cost of Capital

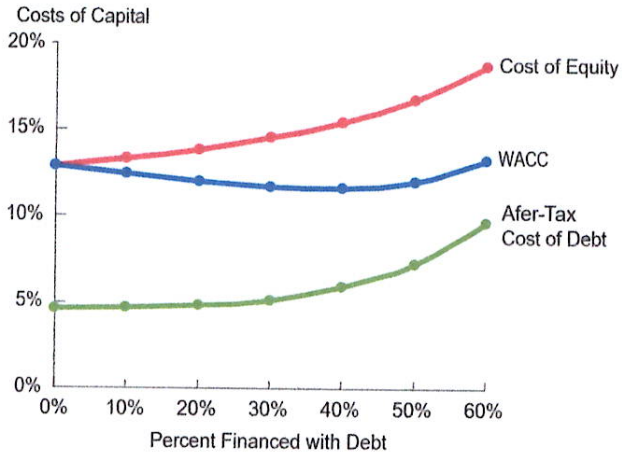
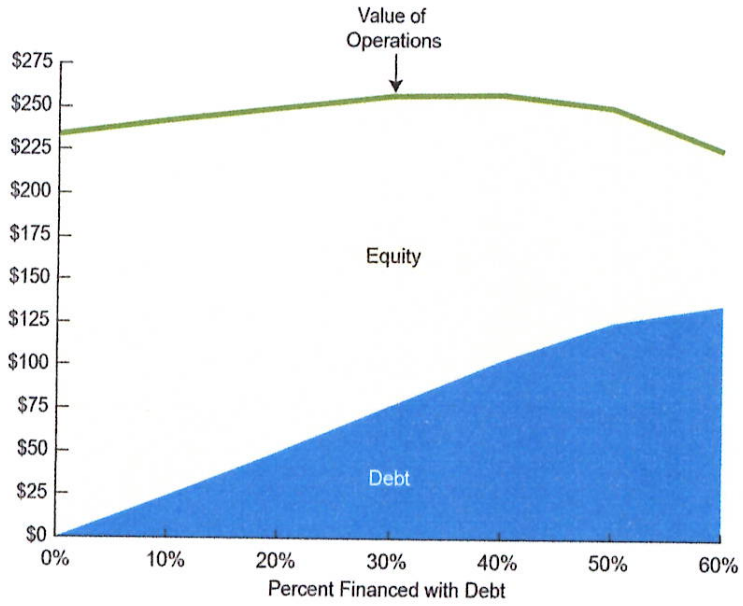


FIGURE 15-8
Effects of Capital Structure on the Value of Operations (Millions of Dollars)



Notice that the value of the firm initially increases but then begins to fall. As discussed earlier, the value initially rises because the WACC initially falls. But the rising costs of equity and debt eventually cause the WACC to increase, causing the value of the firm to fall. Notice how flat the curve is around the optimal level of debt. Thus, it doesn't make a great deal of difference whether Strasburg's capital structure has 30% debt or

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40% debt. Also, notice that the maximum value is about 10% greater than the value with no debt. Although this example is for a single company, the results are not unrealistic: The optimal capital structure for most firms can add 2% to 15% more value relative to zero debt, and there is a fairly wide range of w_d (from about 20% to 50%) over which value changes very little.

Figures 15-5 and 15-8 also show the values of debt and equity for each capital structure. The value of debt is found by multiplying the value of operations by the percentage of the firm that is financed by debt: Debt $= w_d \times V_{op}$. The intrinsic value of equity is found in a similar manner: $S = V_{op} - \text{Debt} = w_s \times V_{op}$. Even though the intrinsic value of equity falls as debt increases, the wealth of shareholders is maximized at the maximum value of operations, as we explain in the next section.

SELF-TEST

What happens to the costs of debt and equity when leverage increases? Explain.

Use the Hamada equation to calculate the unlevered beta for JAB Industries, assuming the following data: Levered beta = b = 1.4; T = 40%; w_d = 45%. **(0.939)**

Suppose r_{RF} = 6% and RP_M = 5%. What would be the cost of equity for JAB Industries if it had no debt? **(10.7%)** *If w_d were 45%?* **(13.0%)**

15-7 Anatomy of a Recapitalization

Strasburg should **recapitalize**, meaning that it should issue enough additional debt to optimize its capital structure, and then use the debt proceeds to repurchase stock. As shown in Figure 15-5, a capital structure with 40% debt is optimal. But before tackling the **recap**, as it is commonly called, let's consider the sequence of events, starting with the situation before Strasburg issues any additional debt. Figure 15-4 shows the valuation analysis of Strasburg at a capital structure consisting of 20% debt and 80% equity. These results are repeated in Column 1 of Figure 15-9, along with the shareholder wealth, which consists entirely of $200 million in stock before the repurchase. The next step is to examine the impact of Strasburg's debt issuance.

15-7a Strasburg Issues New Debt but Has Not Yet Repurchased Stock

The next step in the recap is to issue debt and announce the firm's intent to repurchase stock with the newly issued debt. At the optimal capital structure of 40% debt, the value of the firm's operations is $257.86 million, as calculated in Figure 15-5 and repeated in Column 2 of Figure 15-9. This value of operations is greater than the $250 million value of operations for w_d = 20% because the WACC is lower. Notice that Strasburg raised its debt from $50 million to $103.14 million, an increase of $53.14 million. Because Column 2 reports data prior to the repurchase, Strasburg has short-term investments in the amount of $53.14 million, the amount that was raised in the debt issuance but that has not yet been used to repurchase stock.[34] As Figure 15-9 shows, Strasburg's intrinsic value of equity is $207.86 million.

[34]These calculations are shown in the *Excel* file ***Ch15 Tool Kit.xlsx*** on the textbook's Web site. The values reported in the text are rounded, but the values used in calculations in the spreadsheet are not rounded.

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FIGURE 15-9
Anatomy of a Recapitalization (Millions, Except for Per Share Data)

	A	B	C	D	E
317					
318			Before Issuing Additional Debt (1)	After Debt Issue, but Prior to Repurchase (2)	Post Repurchase (3)
319					
320					
321					
322	Percent financed with debt: w_d		20%	40%	40%
323					
324	Value of operations		$250.00	$257.86	$257.86
325	+ Value of ST investments		0.00	53.14	0.00
326	Estimated total intrinsic value		$250.00	$311.00	$257.86
327	Debt		50.00	103.14	103.14
328	Estimated intrinsic value of equity		$200.00	$207.86	$154.72
329	÷ Number of shares		10.00	10.00	7.44
330	Estimated intrinsic price per share		$20.00	$20.79	$20.79
331					
332	Value of stock		$200.00	$207.86	$154.72
333	+ Cash distributed in repurchase		0.00	0.00	53.14
334	Wealth of shareholders		$200.00	$207.86	$207.86

Source: See the file ***Ch15 Tool Kit.xlsx.*** Numbers are reported as rounded values for clarity, but are calculated using *Excel*'s full precision. Thus, intermediate calculations using the figure's rounded values will be inexact.

Notes:

1. The value of ST investments in Column 2 is equal to the amount of cash raised by issuing additional debt. This cash has not yet been used to repurchase shares, so it is held in the form of short-term investments: ST investments $= D_{New} - D_{Old}$.
2. The value of ST investments in Column 3 is zero because the funds have been used to repurchase shares of stock.
3. The number of shares in Column 3 reflects the shares repurchased: $n_{Post} = n_{Prior} - (Cash_{Rep}/P_{Prior}) = n_{Prior} - [(D_{New} - D_{Old})/P_{Prior}]$.

Because Strasburg has not yet repurchased any stock, it still has 10 million shares outstanding. Therefore, the price per share after the debt issue but prior to the repurchase is:

$$P_{Prior} = S_{Prior}/n_{Prior}$$
$$= \$207.86/10 = \$20.79$$

Column 2 of Figure 15-9 summarizes these calculations and also shows the wealth of the shareholders. The shareholders own Strasburg's equity, which is worth $207.86 million. Strasburg has not yet made any cash distributions to shareholders, so the total wealth of shareholders is $207.86 million. The new wealth of $207.86 million is greater than the initial wealth of $200 million, so the recapitalization has added value to Strasburg's shareholders. This increase in value comes from reducing the amount of taxes Strasburg pays and represents a transfer of value from the government to Strasburg's shareholders. By increasing the level of debt, interest expense increases and taxes go down. Notice also that the recapitalization caused the intrinsic stock price to increase from $20.00 to $20.79.[35]

[35]The increase in value is, in principle, the present value of the new interest tax shields as in Equation 15-8. Hamada's formula for levering beta, Equation 15-11, was developed for the special case in which debt is risk free. Since $r_d > r_{Rf}$ in this example, the additional value doesn't exactly equal the present value of the tax shields. Chapter 21 develops an equation similar to Equation 15-11 that deals with risky debt, and when it is used to lever and unlever beta, the additional value from a recapitalization is precisely equal to the present value of the new interest tax shields.

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Summarizing these results, we see that the issuance of debt and the resulting change in the optimal capital structure caused: (1) the WACC to decrease, (2) the value of operations to increase, (3) shareholder wealth to increase, and (4) the stock price to increase.

15-7b Strasburg Repurchases Stock

What happens to the stock price during the repurchase? In Chapter 14, we discussed repurchases and showed that a repurchase does not change the stock price. It is true that the additional debt will change the WACC and the stock price prior to the repurchase (P_{Prior}), but the subsequent repurchase itself will not affect the post-repurchase stock price (P_{Post}).[36] Therefore, $P_{Post} = P_{Prior}$. (Keep in mind that P_{Prior} is the price immediately prior to the repurchase, not the price prior to announcing the recapitalization and issuing the debt.)

Strasburg uses the entire amount of cash raised by the debt issue to repurchase stock. The total cash raised is equal to $D_{New} - D_{Old}$. The number of shares repurchased is equal to the cash raised by issuing debt divided by the repurchase price:

$$\text{Number of shares repurchased} = \frac{D_{New} - D_{Old}}{P_{Prior}} \tag{15-13}$$

Strasburg repurchases ($103.14 – $50)/$20.79 = 2.56 million shares of stock.

The number of remaining shares after the repurchase, n_{Post}, is equal to the initial number of shares minus the number that is repurchased:

$$\begin{aligned} n_{Post} &= \text{Number of outstanding shares remaining after the repurchase} \\ &= n_{Prior} - \text{Number of shares repurchased} \\ &= n_{Prior} - \frac{D_{New} - D_{Old}}{P_{Prior}} \end{aligned} \tag{15-14}$$

For Strasburg, the number of remaining shares after the repurchase is:

$$\begin{aligned} n_{Post} &= n_{Prior} - (D_{New} - D_{Old})/P_{Prior} \\ &= 10 - (\$103.14 - \$50)/\$20.79 \\ &= 7.44 \text{ million} \end{aligned}$$

Column 3 of Figure 15-9 summarizes these post-repurchase results. The repurchase doesn't change the value of operations, which remains at $257.86 million. However, the short-term investments are sold and the cash is used to repurchase stock. Strasburg is left with no short-term investments, so the intrinsic value of equity is:

$$S_{Post} = \$257.86 - \$103.14 = \$154.72 \text{ million}$$

[36] As we discuss in Chapter 14, a stock repurchase may be a signal of a company's future prospects or it may be the way a company "announces" a change in capital structure, and either of these situations could have an impact on estimated free cash flows or WACC. However, neither situation applies to Strasburg.

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After the repurchase, Strasburg has 7.44 million shares of stock. We can verify that the intrinsic stock price has not changed:[37]

$$P_{Post} = S_{Post}/n_{Post} = \$154.72/7.44 = \$20.79$$

Shareholders now own an equity position in the company worth only $154.72 million, but they have received a cash distribution in the amount of $53.14 million, so their total wealth is equal to the value of their equity plus the amount of cash they received: $154.72 + $53.14 = $207.86.

Here are some points worth noting. As shown in Column 3 of Figure 15-9, the change in capital structure clearly added wealth to the shareholders, increased the price per share, and increased the cash (in the form of short-term investments) temporarily held by the company. However, the repurchase itself did not affect shareholder wealth or the price per share. The repurchase did reduce the cash held by the company and the number of shares outstanding, but shareholder wealth stayed constant. After the repurchase, shareholders directly own the funds used in the repurchase; before the repurchase, shareholders indirectly own the funds. In either case, shareholders own the funds. The repurchase simply takes them out of the company's account and puts them into the shareholders' personal accounts.

The approach we've described here is based on the corporate valuation model, and it will always provide the correct values for S_{Post}, n_{Post}, and P_{Post}. However, there is a quicker way to calculate these values if the firm has no short-term investments either before or after the recap (other than the temporary short-term investments held between the time debt was issued and shares repurchased). After the recap is completed, the percentage of equity in the capital structure, based on market values, is equal to $1 - w_d$ if the firm holds no other short-term investments. Therefore, the value of equity after the repurchase is:

$$S_{Post} = V_{opNew}(1 - w_d) \tag{15-15}$$

where we use the subscript "New" to indicate the value of operations at the new capital structure and the subscript "Post" to indicate the post-repurchase intrinsic value of equity.

The post-repurchase number of shares can be found using this equation:

$$n_{Post} = n_{Prior}\left[\frac{V_{opNew} - D_{New}}{V_{opNew} - D_{Old}}\right] \tag{15-16}$$

Given the value of equity and the number of shares, it is straightforward to calculate the intrinsic price per share as $P_{Post} = S_{Post}/n_{Post}$. But we can also calculate the post-repurchase price using:

$$P_{Post} = \frac{V_{opNew} - D_{Old}}{n_{Prior}} \tag{15-17}$$

[37]There may be a small rounding difference due to using rounded numbers in intermediate steps. See the *Excel* file ***Ch15 Tool Kit.xlsx*** for the exact calculations.

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FIGURE 15-10
Effects of Capital Structure on Stock Price and Earnings per Share

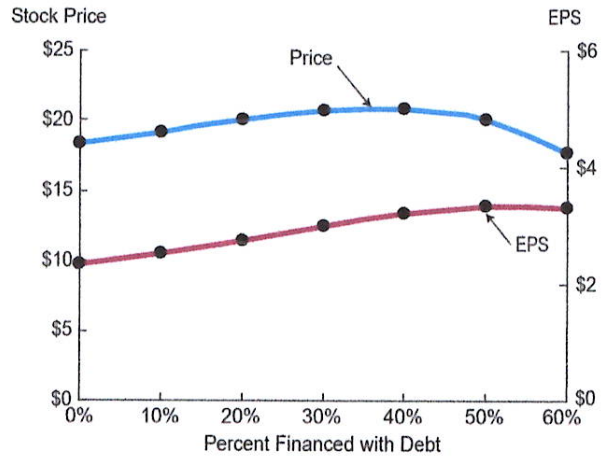

Figure 15-5 reports the number of shares and the intrinsic price per share in Lines 10–11. Notice that the number of shares goes down as debt goes up because the debt proceeds are used to buy back stock. Notice also that the capital structure that maximizes stock price, $w_d = 40\%$, is the same capital structure that optimizes the WACC and the value of operations.

Figure 15-5 also reports the earnings per share for the different levels of debt. Figure 15-10 graphs the intrinsic price per share and the earnings per share. Notice that the maximum earnings per share is at 50% debt even though the optimal capital structure is at 40% debt. This means that maximizing EPS will not maximize shareholder wealth.

15-7c Recapitalization: A Post-Mortem

In Chapter 12, we saw how a company can increase its value by improving its operations. There is good news and bad news regarding this connection. The good news is that small improvements in operations can lead to huge increases in value. The bad news is that it's often difficult to improve operations, especially if the company is already well managed and is in a competitive industry.

If instead you seek to increase a firm's value by changing its capital structure, we again have good news and bad news. The good news is that changing capital structure is easy—just call an investment banker and issue debt (or issue equity if the firm has too much debt). The bad news is that this will add only a relatively small amount of value. Of course, any additional value is better than none, so it's hard to understand why there are some mature firms with zero debt.

Finally, some firms have more debt than is optimal and should recapitalize to a lower debt level. This is called *deleveraging*. We can use exactly the same approach and the same formulas as we used for Strasburg. The difference is that the debt will go down and the number of shares will go up. In other words, the company will issue new shares of stock and then use the proceeds to pay off debt, resulting in a capital structure with less debt and lower interest payments.

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Deleveraging

Many households, nonfinancial businesses, and financial institutions loaded up on easy credit during the run-up to the global economic crisis and found themselves with too much debt during the recession that began in 2007. The process of reducing debt is called *deleveraging*, and it is painful for individuals and the economy.

The debt-to-income ratio for households increased from around 80%–90% during the 1990s to a peak of 133% in 2007. To deleverage, many households cut spending on consumer goods and paid off some of their debt. This belt-tightening is difficult for the individual households, but it also is difficult for the economy because decreased spending leads to economic contraction and job losses. Other households deleveraged by declaring bankruptcy, with over 1.5 million people filing in 2010.

Like individuals, businesses can deleverage by paying off debt or by declaring bankruptcy, and many did so during this global economic crisis. But businesses can also deleverage by issuing equity. For example, Dunkin' Brands Group, owner of the Dunkin' Donuts and Baskin-Robbins brands, issued $427 million in stock in July 2011, part of which was used to pay down debt. And Wells Fargo and Morgan Stanley issued over $12 billion in stock in May 2009. A problem with deleveraging via stock issuances is that the stock price usually has been beaten down so much by the time of deleveraging that the new investors get a larger stake in the company, which dilutes the existing stockholders. But the bottom line is that dilution is better than bankruptcy!

Sources: Reuven Glick and Kevin J. Lansing, "U.S. Household Deleveraging and Future Consumption Growth," FRBSF Economic Letter, May 15, 2009, **www.frbsf.org/publications/economics/letter/2009/el2009-16.pdf;** and BankruptcyAction.com, **www.bankruptcyaction.com/USbankstats.htm,** May 2009.

SELF-TEST

A firm's value of operations is equal to $800 million after a recapitalization. (The firm had no debt before the recap.) The firm raised $200 million in new debt and used this to buy back stock. The firm had no short-term investments before or after the recap. After the recap, $w_d = 25\%$. *The firm had 10 million shares before the recap. What is S (the value of equity after the recap)?* **($600 million)** *What is* P_{Post} *(the stock price after the recap)?* **($80/share)** *What is* n_{Post} *(the number of remaining shares after the recap)?* **(7.5 million)**

15-8 Risky Debt and Equity as an Option

In the previous sections, we evaluated equity and debt using the standard discounted cash flow techniques. However, we saw in Chapter 11 that if there is an opportunity for management to make a change as a result of new information after a project or investment has been started, then there might be an option component to the project or investment being evaluated. This type of opportunity also applies to managers of levered firms.

For example, consider Kunkel Inc., a small manufacturer of electronic wiring harnesses and instrumentation located in Minot, North Dakota. Kunkel has just issued some zero coupon bonds which mature in 5 years and have a $10 million face value. Kunkel plans to invest the debt proceeds in several new projects. What decision will management make when the debt comes due? The answer depends on how much the firm is worth in 5 years.

Suppose the company is worth a total of $22 million in 5 years. In this case, it will pay off the $10 million loan, either by liquidating assets or refinancing the debt. Either way, the stockholders' net value is $12 million:

$$\begin{aligned}\text{Value of equity} &= \text{Total value} - \text{Face value due on debt}\\ &= \$22 - \$10 = \$12 \text{ million}\end{aligned}$$

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Now suppose that business has gone poorly and the firm is worth only $9 million in 5 years. In that case, the firm is economically bankrupt, because its value is less than the amount of debt due. Management will choose to default on the loan and turn the company over to the debtholders, who will either keep the company or sell it. Either way, the original stockholders' value will be zero.

Notice that the stockholders' value in 5 years resembles a call option with a strike price equal to the loan amount—the stockholders get zero if the company is worth less than the loan's face value but they get the excess if the company is worth more than the face value. We can apply the same option pricing techniques from Chapter 8 to estimate the value of equity and to provide insights into managerial risk incentives.

15-8a Using the Black-Scholes Option Pricing Model to Value Equity

Recall from Chapter 8 that the value of a call option depends on five factors: the price of the underlying asset, the strike price (X), the risk-free rate (r_{RF}), the time to expiration (T), and the volatility of the market value of the underlying asset (σ). When applied to a levered firm, the underlying asset is the total value of the firm (denoted here by P instead of V_L to show how it is used in the Black-Scholes model). The strike price is the face value of the debt and the expiration date is the bond's maturity date.

resource

*See **Ch15 Tool Kit.xlsx** on the textbook's Web site for all calculations.*

The total value of the firm at the time it issues the debt but before it has yet invested the proceeds is the value of operations (which reflects expected future free cash flows of existing assets and growth plans) plus the proceeds from issuing debt. For Kunkel, the total value is $20 million when the debt is issued, the volatility is 40%, and the risk-free rate is 6%. The inputs for the Black-Scholes model are as follows:

$$\begin{aligned} P &= \$20 \text{ million} \\ X &= \$10 \text{ million} \\ t &= 5 \text{ years} \\ r_{RF} &= 6\% \\ \sigma &= 40\% \end{aligned}$$

The value of a European call option, as shown in Chapter 8, is:

$$V_0 = P[N(d_1)] - Xe^{-r_{RF}t}[N(d_2)] \tag{15-18}$$

where

$$d_1 = \frac{\ln(P/X) + (r_{RF} + \sigma^2/2)t}{\sigma\sqrt{t}} \text{ and } d_2 = d_1 - \sigma\sqrt{t} \tag{15-19}$$

Using the inputs for Kunkel, the values of d_1 and d_2 are:

$$d_1 = \frac{\ln(20/10) + (0.06 + 0.40^2/2)5}{0.40\sqrt{5}} = 1.5576$$

$$d_2 = 1.5576 - 0.40\sqrt{5} = 0.6632$$

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Using the *Excel* **NORMSDIST** function gives $N(d_1) = N(1.5576) = 0.9403$, $N(d_2) = N(0.6632) = 0.7464$. Using Equation 15-18, the Black-Scholes value is:

$$V = \$20(0.9403) - \$10e^{-0.06(5)}(0.7464) = \$13.28 \text{ million}$$

This means that the value of Kunkel's equity at the time it issues debt is $13.28 million. Because the values of debt and equity must sum to the total value of $20 million, the value of Kunkel's debt (at the issue date) is:

$$\begin{aligned}\text{Debt value} &= \text{Total value} - \text{Equity value} \\ &= \$20 - \$13.28 = \$6.72 \text{ million}\end{aligned}$$

Recall from Chapter 4 that we can determine the rate (I) on a single future value (FV) at Year N if we know the present value (PV):

$$I = [(FV/PV)^{(1/N)}] - 1 \qquad (15\text{-}20)$$

The rate on the zero coupon bond is its yield to maturity, so we can apply Equation 15-20 to determine the yield on the bond at the time it is issued:

$$\text{Yield on debt} = [(\$10/\$6.72)^{(1/5)}] - 1 = 0.0827 = 8.27\%$$

Thus, when Kunkel issues the debt, it receives $6.72 million and the yield on the debt is 8.27%. Notice that the yield on the debt, 8.27%, is greater than the 6% risk-free rate because the debt has default risk. In particular, the debtholders expect Kunkel to invest in projects with a total volatility of 40%, which means it is possible that the company will be worth less than $10 million when the debt matures.

15-8b Managerial Risk Incentives

The debt's yield depends on debtholders' perception of Kunkel's risk, which is determined in part by what debtholders expect management to do with the $6.72 million debt proceeds. Suppose Kunkel's management can find a way to increase future free cash flow volatility without reducing the value of operations (i.e., invest in projects that maintain NPV but that have higher risk). This will not change the total value of the firm, but it will change the relative values of debt and equity because the value of equity is like a call option on the firm's value (recall from Chapter 8 that options are worth more when volatility is higher). Table 15-2 shows different levels of volatility that correspond to management's choice of projects. For each volatility level, the table reports the total value, the value of equity, and the value of debt.

Notice in Table 15-2 that the total value remains constant because management is accepting projects with identical NPVs even though they have different risk levels. The row for 40% volatility (shown in blue) reports the values expected by the lenders *before* the debt is issued. However, suppose management instead undertakes projects that increase its risk from a volatility of 40% to a volatility of 80% *after* the debt is issued. This will cause Kunkel's equity to increase in value by $2.53 million to $15.81 million, which is a 19% gain. Notice that the value of debt will decrease by the same dollar amount. Therefore, increasing risk causes a transfer of wealth from bondholders to stockholders. The reverse occurs if Kunkel undertakes projects that are safer than originally planned.

Investing borrowed funds in riskier assets than anticipated by lenders is called **bait and switch** because the firm obtains the money by promising one investment policy and then switches to another policy. The bait-and-switch problem is more severe when

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TABLE 15-2
The Value of Kunkel's Debt and Equity for Various Levels of Volatility (Millions of Dollars)

Standard Deviation of Total Value	Total Value	Value of Equity	Value of Debt
20%	$20	$12.62	$7.38
40	20	14.51	5.49
60	20	16.96	3.04
80	20	13.28	6.72
100	20	15.81	4.19

Source: Numbers in the table are shown as rounded values for clarity in reporting. However, unrounded values are used for all calculations. See the *Excel* ***Tool Kit*** for this chapter.

a firm's value is low relative to its level of debt. For example, suppose total value immediately falls to $11 million due to an unexpected change in the business environment. If the volatility remains at 40%, the value of equity drops to $5.25 million and the value of debt drops to $5.75 million (see the ***Tool Kit*** for all calculations). If management now doubles volatility, the equity value increases to $7.69 million, an increase of 46%, coming at the expense of debtholders.[38] Therefore, the incentive for management to "roll the dice" with borrowed funds can be enormous—if management owns many stock options, then their payoff from rolling the dice is even greater than the payoff to stockholders!

Bondholders are aware of these incentives and write covenants into debt issues that restrict management's ability to invest in riskier projects than originally promised. However, their attempts to protect themselves are not always successful, as the failures of Enron, Lehman Brothers, and AIG demonstrate. The combination of a risky industry, high levels of debt, and option-based compensation has proven to be very dangerous.

SELF-TEST

Discuss how equity can be viewed as an option. Who has the option and what decision can they make?

Why would management want to increase the riskiness of the firm? Why would this make bondholders unhappy?

What can bondholders do to limit management's ability to bait and switch?

15-9 Managing the Maturity Structure of Debt

In conjunction with choosing how much debt to have in its capital structure, firms must choose the maturities of the various securities that make up its debt. The following sections explain the factors associated with the choice of maturity structure.

[38]For extremely high volatilities, the yield on the debt is much higher than any reasonable required return on stock; see the ***Tool Kit*** for calculations. When debt is supposedly safer than equity, why would its yield be so high? The answer is that although debtholders are indeed paid before stockholders, they don't get to participate in the very high payouts stockholders receive when the company does extremely well—debtholders only get the face value of the debt in those cases. But when the company does poorly, the debtholders only get to take over a poorly performing company. As the volatility increases, the probability of receiving ownership of a poorly performing company instead of the face value of debt increases, driving down the value of the debt. In the limit, as the volatility continues to increase, the value of the debt is driven to zero. Thus, the debt is actually much riskier than the stock when volatility is high!

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15-9a Maturity Matching

Assume that Consolidated Tools, a Cincinnati machine tool manufacturer, made the decision to float a $25 million nonconvertible bond issue to help finance its 2016 capital budget. It must choose a maturity for the issue, taking into consideration the shape of the yield curve, management's own expectations about future interest rates, and the maturity of the assets being financed. To illustrate how asset maturities affect the choice of debt maturities, suppose Consolidated's capital projects consist primarily of new milling machinery. This machinery has an expected economic life of 10 years (even though it falls into the MACRS 5-year class life). Should Consolidated use debt with a 5-year, 10-year, 20-year, 30-year, or some other maturity?

Note that some of the new capital will come from common equity, which is permanent capital. On the other hand, debt maturities can be specified at the time of issue. If Consolidated financed its capital budget with 10-year sinking fund bonds, it would be matching asset and liability maturities. The cash flows resulting from the new machinery could be used to make the interest and sinking fund payments on the issue, so the bonds would be retired as the machinery wore out.

If Consolidated used 1-year debt, then it would have to pay off this debt with cash flows derived from assets other than the machinery in question. Of course, the 1-year debt could probably be rolled over year after year, out to the 10-year asset maturity. However, if interest rates rose, then Consolidated would have to pay a higher rate when it rolled over its debt, and if the company experienced difficulties, then it might not be able to refund the debt at a reasonable rate. Conversely, if it used 20-year or 30-year debt, it would have to service the debt long after the assets that were purchased with the funds had been scrapped and had ceased providing cash flows. This would worry lenders.

For all these reasons, *the safest all-around financing strategy is to match debt maturities with asset maturities*. In recognition of this fact, firms generally place great emphasis on maturity matching, and this factor often dominates the debt maturity decision.

15-9b Effects of Interest Rate Levels and Forecasts

Financial managers also consider interest rate levels and forecasts, both absolute and relative, when making financing decisions. For example, if long-term interest rates are high by historical standards and are expected to fall, managers will be reluctant to issue long-term debt, which would lock in those costs for long periods. We already know that one solution to this problem is to use a call provision, because callability permits refunding should interest rates drop. This flexibility comes at a cost, however, because of the call premium and also because the firm must set a higher coupon on callable debt. Floating-rate debt could be used, but another alternative would be to finance with short-term debt whenever long-term rates are historically high, and then, assuming that interest rates subsequently fall, sell a long-term issue to replace the short-term debt. Of course, this strategy has its risks: If interest rates move even higher, the firm will be forced to renew its short-term debt at higher and higher rates or to replace the short-term debt with a long-term bond that costs even more than it would have when the original decision was made.

15-9c Information Asymmetries

Consider two types of firms that need to raise funds to finance projects but that have high degrees of asymmetric information. The first type of fund has better prospects than investors expect and the second has worse prospects. How does the information asymmetry affect maturity choice?

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In the first situation, managers may be reluctant to issue common stock because this might be taken as a negative signal. But if they issue debt, the interest rate will be too high because it reflects investors' expectations (which are too pessimistic compared to the better informed expectations of management). Rather than locking in a high rate for a long period, the firm can issue short-term debt. It also will have a too-high interest rate, but it can be refinanced at a lower rate when it comes due and the firm's excellent prospects have been realized.

In the second situation, a company with poorer prospects than expected by the market would wish to issue stock but would also be worried about the negative signal (which is justified in this case). It would prefer to lock in a better interest rate than its true situation warrants, so it would want to issue long-term debt.[39]

15-9d Amount of Financing Required

Obviously, the amount of financing required will influence the financing decision. This is mainly because of flotation costs. A $5 million debt financing, which is small in Wall Street terms, would most likely be done with a term loan or a privately placed bond issue, whereas a firm seeking $2 billion of new debt would most likely use a public offering of long-term bonds.

15-9e Availability of Collateral

Generally, secured debt is less costly than unsecured debt. Thus, firms with large amounts of marketable fixed assets are likely to use a relatively large amount of long-term debt, especially mortgage bonds. Additionally, each year's financing decision would be influenced by the amount of qualified assets available as security for new bonds.

15-9f Evidence on Debt Maturity in Practice

Professors Custódio, Ferreira, and Laureano show that the ratio of total debt to total assets (based on book values) has remained relatively stable at about 27% for the past 40 years for publicly traded companies.[40] However, the mix of long-term debt and short-term debt has changed dramatically. Long-term debt (maturing in more than 5 years) comprised about 62% of all debt financing in 1976, but has dropped to about 40% in recent years. In addition, the average original maturity of publicly issued debt has dropped from over 25 years to 11 years in that same period. What has caused this shift?

Part of the explanation is due to the changing nature of public companies. Before 1990, most IPOs were for relatively mature companies with a strong record of earnings. Since then, many smaller and riskier companies have gone public. Just as fewer of these companies pay dividends (as described in Chapter 14), fewer issue long-term debt. In fact, the maturity mix of debt issued by older companies has not changed significantly.

In general, many public companies today (mature and new) have high levels of informational asymmetry because they compete in complex product environments, including information technology, bio-technology, and pharmaceuticals. Theory suggests that such firms should raise capital from debt rather than equity and should raise short-term debt rather than long-term debt, and this is what the evidence shows.

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[39]If the market expects firms in these two situations to behave as described, then it will interpret the choice of short-term debt versus long-term debt as a signal regarding the quality of the issuer. See M. Flannery, "Asymmetric Information and Risky Debt Maturity Choice," *Journal of Financial Economics,* Vol. 41, 1986, pp. 19–37.

[40]For more details, see C. Custódio, M. Ferreira, and L. Laureano, "Why Are US Firms Using More Short-Term Debt?" *Journal of Financial Economics,* Vol. 108, 2013, pp. 182–212.

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SELF-TEST

What are some factors that financial managers consider when choosing the maturity structure of their debt?

How do information asymmetries affect financing decisions?

SUMMARY

This chapter examined the effects of financial leverage on stock prices, earnings per share, and the cost of capital. The key concepts covered are listed here.

- A firm's **optimal capital structure** is the mix of debt and equity that maximizes the stock price. At any point in time, management has a specific **target capital structure** in mind, presumably the optimal one, but this target may change over time.
- **Business risk** is the risk inherent in the firm's operations if it uses no debt. A firm will have little business risk if the demand for its products is stable, if the prices of its inputs and products remain relatively constant, if it can adjust its prices freely if costs increase, and if a high percentage of its costs are variable and hence will decrease if sales decrease. Other things the same, the lower a firm's business risk, the higher its optimal debt ratio.
- **Financial leverage** is the extent to which fixed-income securities (debt and preferred stock) are used in a firm's capital structure. **Financial risk** is the added risk borne by stockholders as a result of financial leverage.
- **Operating leverage** is the extent to which fixed costs are used in a firm's operations. 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. ***Web Extension 15A*** describes additional measures of operating and financial leverage.
- If there are no corporate or personal taxes, Modigliani and Miller showed that the value of a levered firm is equal to the value of an otherwise identical but unlevered firm:

$$V_L = V_U$$

- If there are only corporate taxes, Modigliani and Miller showed that a firm's value increases as it adds debt due to the interest rate deductibility of debt:

$$V_L = V_U + TD$$

- If there are personal and corporate taxes, Miller showed that:

$$V_L = V_U + \left[1 - \frac{(1 - T_c)(1 - T_s)}{(1 - T_d)}\right]D$$

- The **Hamada equation** shows the effect of financial leverage on beta as follows:

$$b = b_U[1 + (1 - T)(D/S)]$$

- Firms can use their current beta, tax rate, and debt/equity ratio to derive their **unlevered beta, b_U**, as follows:

$$b_U = b/[1 + (1 - T)(D/S)] = b/[1 + (1 - T)(w_d/w_s)]$$

- The **trade-off theory** of capital structure states that debt initially adds value because interest is tax deductible but that debt also brings costs associated with actual or

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potential bankruptcy. The optimal capital structure strikes a balance between the tax benefits of debt and the costs associated with bankruptcy.

- **Signaling theory** assumes that there is **asymmetric information** because managers have more complete information than investors. A stock issue is viewed as a negative signal, whereas a bond issue is a neutral (or small negative) signal. As a result, companies try to avoid having to issue stock by maintaining a **reserve borrowing capacity**, and this means using less debt in "normal" times than the trade-off theory would suggest.
- A firm's owners may decide to use a relatively large amount of debt to constrain the managers. A *high debt ratio raises the threat of bankruptcy,* which not only carries a cost but also forces managers to be more careful and less wasteful with shareholders' money. Many of the corporate takeovers and leveraged buyouts in recent years were designed to improve efficiency by reducing the cash flow available to managers.
- When debt is risky, management may choose to default. If the debt is zero coupon debt, then this makes equity like an option on the value of the firm with a strike price equal to the face value of the debt.
- When a firm has risky debt and equity is like an option, management has an incentive to increase the firm's risk in order to increase the equity value at the expense of the debt value. This is called **bait and switch**.
- ***Web Extension 15B*** provides proofs of the MM propositions.

QUESTIONS

(15-1) Define each of the following terms:

a. Capital structure; business risk; financial risk
b. Operating leverage; financial leverage; break-even point
c. Reserve borrowing capacity

(15-2) What term refers to the uncertainty inherent in projections of future ROIC?

(15-3) Firms with relatively high nonfinancial fixed costs are said to have a high degree of what?

(15-4) "One type of leverage affects both EBIT and EPS. The other type affects only EPS." Explain this statement.

(15-5) Why is the following statement true? "Other things being the same, firms with relatively stable sales are able to carry relatively high debt ratios."

(15-6) Why do public utility companies usually have capital structures that are different from those of retail firms?

(15-7) Why is EBIT generally considered to be independent of financial leverage? Why might EBIT be influenced by financial leverage at high debt levels?

(15-8) If a firm went from zero debt to successively higher levels of debt, why would you expect its stock price to first rise, then hit a peak, and then begin to decline?

(15-9) Your firm's CEO has just learned about options and how your firm's equity can be viewed as an option. Why might he want to increase the riskiness of the firm, and why might the bondholders be unhappy about this?

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