

Chapter 15

Capital Structure and Leverage

Learning Objectives

After reading this chapter, students should be able to:

- ◆ Explain why there may be differences in a firm's capital structure when measured on a book-value basis, a market-value basis, or a target basis.
- ◆ Distinguish between business risk and financial risk, and explain the effects that debt financing has on the firm's expected return and risk.
- ◆ Discuss the analytical framework used when determining the optimal capital structure.
- ◆ Discuss capital structure theory, and use it to explain why firms in different industries tend to have different capital structures.

Lecture Suggestions

This chapter is rather long, but it is also modular, hence sections can be omitted without loss of continuity. Therefore, if you are experiencing a time crunch, you could skip selected sections.

What we cover, and the way we cover it, can be seen by scanning the slides and Integrated Case solution for Chapter 15, which appears at the end of this chapter's solutions. For other suggestions about the lecture, please see the "Lecture Suggestions" in Chapter 2, where we describe how we conduct our classes.

DAYS ON CHAPTER: 3 OF 56 DAYS (50-minute periods)

Answers to End-of-Chapter Questions

- 15-1** Operating leverage is the extent to which fixed costs are used in a firm's operations. If operating leverage is increased (fixed costs are high), then even a small decline in sales can lead to a large decline in profits and in its ROE.
- 15-2**
- a. The break-even point will be lowered.
 - b. The effect on the break-even point is indeterminant. An increase in fixed costs will increase the break-even point. However, a lowering of the variable cost lowers the break-even point. So it's unclear which effect will have the greater impact.
 - c. The break-even point will be increased because fixed costs have increased.
 - d. The break-even point will be lowered.
- 15-3** If sales tend to fluctuate widely, then cash flows and the ability to service fixed charges will also vary. Consequently, there is a relatively large risk that the firm will be unable to meet its fixed charges. As a result, firms in unstable industries tend to use less debt than those whose sales are subject to only moderate fluctuations, or relatively stable sales.
- 15-4** An increase in the personal tax rate makes both stocks and bonds less attractive to investors because it raises the tax paid on dividend and interest income. Changes in personal tax rates will have differing effects, depending on what portion of an investment's total return is expected in the form of interest or dividends versus capital gains. For example, a high personal tax rate has a greater impact on bondholders because more of their return will be taxed sooner at the new higher rate. An increase in the personal tax rate will cause some investors to shift from bonds to stocks because of the attractiveness of capital gains tax deferrals. This raises the cost of debt relative to equity. In addition, a lower corporate tax rate reduces the advantage of debt by reducing the benefit of a corporation's interest deduction that discourages the use of debt. Consequently, the net result would be for firms to use more equity and less debt in their capital structures.
- 15-5**
- a. An increase in the corporate tax rate would encourage a firm to increase the amount of debt in its capital structure because a higher tax rate increases the interest deductibility feature of debt.
 - b. An increase in the personal tax rate would cause investors to shift from bonds to stocks due to the attractiveness of the deferral of capital gains taxes. This would raise the cost of debt relative to equity; thus, firms would be encouraged to use less debt in their capital structures.
 - c. Firms whose assets are illiquid and would have to be sold at "fire sale" prices should limit their use of debt financing. Consequently, this would discourage the firm from increasing the amount of debt in its capital structure.
 - d. If changes to the bankruptcy code made bankruptcy less costly, then firms would tend to increase the amount of debt in their capital structures.
 - e. Firms whose earnings are more volatile and thus have higher business risk, all else equal, face a greater chance of bankruptcy and, therefore, should use less debt than more stable firms.

- 15-6** Biotechnology companies use relatively little debt because their industries tend to be cyclical, oriented toward research, or subject to huge product liability suits. Utility companies, on the other hand, use debt relatively heavily because their fixed assets make good security for mortgage bonds and also because their relatively stable sales make it safe to carry more than average debt.
- 15-7** EBIT depends on sales and operating costs that generally are not affected by the firm's use of financial leverage, because interest is deducted from EBIT. At high debt levels, however, firms lose business, employees worry, and operations are not continuous because of financing difficulties. Thus, financial leverage can influence sales and cost, hence EBIT, if excessive leverage causes investors, customers, and employees to be concerned about the firm's future.
- 15-8** Expected EPS is generally measured as EPS for the coming years, and we typically do not reflect in this calculation any bankruptcy-related costs. Also, EPS does not reflect (in a major way) the increase in risk and r_s that accompanies an increase in the debt ratio, whereas P_0 does reflect these factors. Thus, the stock price will be maximized at a debt level that is lower than the EPS-maximizing debt level.
- 15-9** The tax benefits from debt increase linearly, which causes a continuous increase in the firm's value and stock price. However, bankruptcy-related costs begin to be felt after some amount of debt has been employed, and these costs offset the benefits of debt. See Figure 15.8 in the textbook.
- 15-10** With increased competition after the breakup of AT&T, the new AT&T and the seven Bell operating companies' business risk increased. With this component of total company risk increasing, the new companies probably decided to reduce their financial risk, and use less debt, to compensate. With increased competition the chance of bankruptcy increases and lowering debt usage makes this less of a possibility. If we consider the tax issue alone, interest on debt is tax deductible; thus, the higher the firm's tax rate the more beneficial the deductibility of interest is. However, competition and business risk have tended to outweigh the tax aspect as we can see from the actual debt ratios of the Bell companies.
- 15-11** The firm may want to assess the asset investment and financing decisions jointly. For instance, the highly automated process would require fancy, new equipment (capital intensive) so fixed costs would be high. A less automated production process, on the other hand, would be labor intensive, with high variable costs. If sales fell, the process that demands more fixed costs might be detrimental to the firm if it has much debt financing. The less automated process, however, would allow the firm to lay off workers and reduce variable costs if sales dropped; thus, debt financing would be more attractive. Operating leverage and financial leverage are interrelated. The highly automated process would increase the firm's operating leverage; thus, its optimal capital structure would call for less debt. On the other hand, the less automated process would call for less operating leverage; thus, the firm's optimal capital structure would call for more debt.

Solutions to End-of-Chapter Problems

15-1 $Q_{BE} = \frac{F}{P - V}$

$$Q_{BE} = \frac{\$500,000}{\$4.00 - \$3.00}$$

$$Q_{BE} = 500,000 \text{ units.}$$

- 15-2** The optimal capital structure is that capital structure where WACC is minimized and stock price is maximized. Because Armada's stock price is maximized at a 30% debt-to-capital ratio, the firm's optimal capital structure is 30% debt and 70% equity. This is also the debt level where the firm's WACC is minimized.

- 15-3 a.** Expected EPS for Firm C:

$$\begin{aligned} E(\text{EPS}_C) &= 0.1(-\$2.40) + 0.2(\$1.35) + 0.4(\$5.10) + 0.2(\$8.85) + 0.1(\$12.60) \\ &= -\$0.24 + \$0.27 + \$2.04 + \$1.77 + \$1.26 = \$5.10. \end{aligned}$$

(Note that the table values and probabilities are dispersed in a symmetric manner such that the answer to this problem could have been obtained by simple inspection.)

- b.** According to the standard deviations of EPS, Firm B is the least risky, while C is the riskiest. However, this analysis does not consider portfolio effects—if C's earnings increase when most other companies' decline (that is, its beta is low), its apparent riskiness would be reduced. Also, standard deviation is related to size, or scale, and to correct for scale we could calculate a coefficient of variation (σ/mean):

	<u>E(EPS)</u>	<u>σ</u>	<u>$CV = \sigma/E(\text{EPS})$</u>
A	\$5.10	\$3.61	0.71
B	4.20	2.96	0.70
C	5.10	4.11	0.81

By this criterion, C is still the most risky.

- 15-4** From the Hamada equation, $b = b_U[1 + (1 - T)(D/E)]$, we can calculate b_U as $b_U = b/[1 + (1 - T)(D/E)]$.

$$b_U = 1.2/[1 + (1 - 0.4)(\$2,000,000/\$8,000,000)]$$

$$b_U = 1.2/[1 + 0.15]$$

$$b_U = 1.0435.$$

15-5 a. $ROIC = \frac{EBIT(1 - T)}{\text{Total capital}}$.

The ROIC for both firms is calculated as: $\frac{\$4,000,000(0.6)}{\$20,000,000} = 12\%$.

b. MAAKL: Debt/Capital = 30%.

EBIT	\$4,000,000
Interest (\$6,000,000 × 0.10)	<u>600,000</u>
EBT	\$3,400,000
Tax (40%)	<u>1,360,000</u>
Net income	<u>\$2,040,000</u>

Return on equity = \$2,040,000/\$14,000,000 = 14.6%.

Pacific Dana: Debt/Capital = 50%.

EBIT	\$4,000,000
Interest (\$10,000,000 × 0.12)	<u>1,200,000</u>
EBT	\$2,800,000
Tax (40%)	<u>1,120,000</u>
Net income	<u>\$1,680,000</u>

Return on equity = \$1,680,000/\$10,000,000 = 16.8%.

c. MAAKL: Debt/Capital = 60%.

EBIT	\$4,000,000
Interest (\$12,000,000 × 0.15)	<u>1,800,000</u>
EBT	\$2,200,000
Tax (40%)	<u>880,000</u>
Net income	<u>\$1,320,000</u>

Return on equity = \$1,320,000/\$8,000,000 = 16.5%.

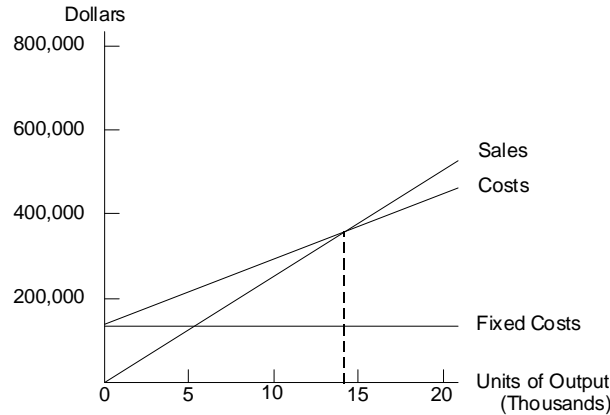
Although MAAKL's return on equity is higher than it was at the 30% leverage ratio, it is lower than the 16.8% return of Pacific Dana.

Initially, as leverage is increased, the return on equity also increases. But, the interest rate rises when leverage is increased. Therefore, the return on equity will reach a maximum and then decline.

15-6 a.	<u>8,000 units</u>	<u>18,000 units</u>
Sales	\$200,000	\$450,000
Fixed costs	140,000	140,000
Variable costs	<u>120,000</u>	<u>270,000</u>
Total costs	<u>\$260,000</u>	<u>\$410,000</u>
Gain (loss)	<u>(\$ 60,000)</u>	<u>\$ 40,000</u>

b. $Q_{BE} = \frac{F}{P - V} = \frac{\$140,000}{\$10} = 14,000 \text{ units.}$

$S_{BE} = Q_{BE}(P) = (14,000)(\$25) = \$350,000.$



- c. If the selling price rises to \$31, while the variable cost per unit remains fixed, $P - V$ rises to \$16. The end result is that the break-even point is lowered.

$Q_{BE} = \frac{F}{P - V} = \frac{\$140,000}{\$16} = 8,750 \text{ units.}$

$S_{BE} = Q_{BE}(P) = (8,750)(\$31) = \$271,250.$



The break-even point drops to 8,750 units. The contribution margin per each unit sold has been increased; thus the variability in the firm's profit stream has been increased, but the opportunity for magnified profits has also been increased.

- d. If the selling price rises to \$31 and the variable cost per unit rises to \$23, $P - V$ falls to \$8. The end result is that the break-even point increases.

$Q_{BE} = \frac{F}{P - V} = \frac{\$140,000}{\$8} = 17,500 \text{ units.}$

$S_{BE} = Q_{BE}(P) = (17,500)(\$31) = \$542,500.$

The break-even point increases to 17,500 units because the contribution margin per each unit sold has decreased.



15-7 a. $Q_{BE} = F / (P - V) = \$73,500 / (\$13.98 - \$10.48) = 21,000$ CDs

b. Total operating costs at break-even point = $FC + (Q \times VC)$
 $= \$73,500 + (21,000 \times \$10.48)$
 $= \$293,580$

c. If TA Global can sell $2,000 \times 12 = 24,000$ CDs per year. 2,000 CDs per month exceeds the operating break-even point of 3,000 CDs per year. Thus, TA Global should open the music store.

d. $EBIT = (P \times Q) - FC - (VC \times Q)$
 $= (\$13.98 \times 24,000) - \$73,500 - (\$10.48 \times 24,000)$
 $= \$335,520 - \$73,500 - \$251,520$
 $= \$10,500$

15-8 a. $Q_{BE} = F / (P - VC) = \$40,000 / (\$10 - \$8) = 20,000$ books

b. $Q_{BE} = \$44,000 / (\$10 - \$8) = 22,000$ books

c. $Q_{BE} = \$40,000 / (\$10.50 - \$8) = 16,000$ books

15-9 No leverage: Debt = 0; Equity = \$14,000,000.

State	P_s	EBIT	$(EBIT - r_d D)(1 - T)$	ROE_s	$P_s(ROE)$	$P_s(ROE_s - \hat{ROE})^2$
1	0.2	\$4,200,000	\$2,520,000	0.18	0.036	0.00113
2	0.5	2,800,000	1,680,000	0.12	0.060	0.00011
3	0.3	700,000	420,000	0.03	0.009	0.00169
				$\hat{ROE} =$	<u>0.105</u>	
				Variance =		<u>0.00293</u>
				Standard deviation =		<u>0.054</u>

$\hat{ROE} = 10.5\%$.

$\sigma^2 = 0.00293$.

$\sigma = 5.4\%$.

$CV = \sigma / \hat{ROE} = 5.4\% / 10.5\% = 0.514$.

Leverage ratio = 10%: Debt = \$1,400,000; Equity = \$12,600,000; $r_d = 9\%$.

State	P_s	EBIT	$(EBIT - r_d D)(1 - T)$	ROE_s	$P_s(ROE)$	$P_s(ROE_s - \hat{ROE})^2$
1	0.2	\$4,200,000	\$2,444,400	0.194	0.039	0.00138
2	0.5	2,800,000	1,604,400	0.127	0.064	0.00013
3	0.3	700,000	344,400	0.027	<u>0.008</u>	<u>0.00212</u>
				$\hat{ROE} =$	<u>0.111</u>	
					Variance =	<u>0.00363</u>
					Standard deviation =	<u>0.060</u>

$\hat{ROE} = 11.1\%$.

$\sigma^2 = 0.00363$.

$\sigma = 6\%$.

$CV = 6\%/11.1\% = 0.541$.

Leverage ratio = 50%: Debt = \$7,000,000; Equity = \$7,000,000; $r_d = 11\%$.

State	P_s	EBIT	$(EBIT - r_d D)(1 - T)$	ROE_s	$P_s(ROE)$	$P_s(ROE_s - \hat{ROE})^2$
1	0.2	\$4,200,000	\$2,058,000	0.294	0.059	0.00450
2	0.5	2,800,000	1,218,000	0.174	0.087	0.00045
3	0.3	700,000	(42,000)	(0.006)	<u>(0.002)</u>	<u>0.00675</u>
				$\hat{ROE} =$	<u>0.144</u>	
					Variance =	<u>0.01170</u>
					Standard deviation =	<u>0.108</u>

$\hat{ROE} = 14.4\%$.

$\sigma^2 = 0.01170$.

$\sigma = 10.8\%$.

$CV = 10.8\%/14.4\% = 0.750$.

Leverage ratio = 60%: D = \$8,400,000; E = \$5,600,000; $r_d = 14\%$.

State	P_s	EBIT	$(EBIT - r_d D)(1 - T)$	ROE_s	$P_s(ROE)$	$P_s(ROE_s - \hat{ROE})^2$
1	0.2	\$4,200,000	\$1,814,400	0.324	0.065	0.00699
2	0.5	2,800,000	974,400	0.174	0.087	0.00068
3	0.3	700,000	(285,600)	(0.051)	<u>(0.015)</u>	<u>0.01060</u>
				$\hat{ROE} =$	<u>0.137</u>	
					Variance =	<u>0.01827</u>
					Standard deviation =	<u>0.135</u>

$\hat{ROE} = 13.7\%$.

$\sigma^2 = 0.01827$.

$\sigma = 13.5\%$.

$CV = 13.5\%/13.7\% = 0.985 \approx 0.99$.

As leverage increases, the expected return on equity rises up to a point. But as the risk increases with increased leverage, the cost of debt rises. So after the return on equity peaks, it then begins to fall. As leverage increases, the measures of risk (both the standard deviation and the coefficient of variation of the return on equity) rise with each increase in leverage.

15-10 Facts as given: Current capital structure: 25% debt, 75% equity; $r_{RF} = 5\%$; $r_M - r_{RF} = 6\%$; $T = 40\%$; $r_s = 14\%$.

Step 1: Determine the firm's current beta.

$$\begin{aligned} r_s &= r_{RF} + (r_M - r_{RF})b \\ 14\% &= 5\% + (6\%)b \\ 9\% &= 6\%b \\ 1.5 &= b. \end{aligned}$$

Step 2: Determine the firm's unlevered beta, b_U .

$$\begin{aligned} b_U &= b_L/[1 + (1 - T)(D/E)] \\ &= 1.5/[1 + (1 - 0.4)(0.25/0.75)] \\ &= 1.5/1.20 \\ &= 1.25. \end{aligned}$$

Step 3: Determine the firm's beta under the new capital structure.

$$\begin{aligned} b_L &= b_U[1 + (1 - T)(D/E)] \\ &= 1.25[1 + (1 - 0.4)(0.5/0.5)] \\ &= 1.25(1.6) \\ &= 2. \end{aligned}$$

Step 4: Determine the firm's new cost of equity under the changed capital structure.

$$\begin{aligned} r_s &= r_{RF} + (r_M - r_{RF})b \\ &= 5\% + (6\%)2 \\ &= 17\%. \end{aligned}$$

15-11 a. The current dividend per share, D_0 , = $\$400,000/200,000 = \2.00 . $D_1 = \$2.00(1.05) = \2.10 . Therefore, $P_0 = D_1/(r_s - g) = \$2.10/(0.134 - 0.05) = \25.00 .

b. Step 1: Calculate EBIT before the recapitalization:

$$\text{EBIT} = \$1,000,000/(1 - T) = \$1,000,000/0.6 = \$1,666,667.$$

Note: The firm is 100% equity financed, so there is no interest expense.

Step 2: Calculate net income after the recapitalization:

$$[\$1,666,667 - 0.11(\$1,000,000)]0.6 = \$934,000.$$

Step 3: Calculate the number of shares outstanding after the recapitalization:

$$200,000 - (\$1,000,000/\$25) = 160,000 \text{ shares.}$$

Step 4: Calculate D_1 after the recapitalization:

$$D_0 = 0.4(\$934,000/160,000) = \$2.335.$$

$$D_1 = \$2.335(1.05) = \$2.45175.$$

Step 5: Calculate P_0 after the recapitalization:

$$P_0 = D_1/(r_s - g) = \$2.45175/(0.145 - 0.05) = \$25.8079 \approx \$25.81.$$

15-12 a. Firm A

1. Fixed costs = \$80,000.
2. Variable cost/unit =
$$\frac{\text{Break-even sales} - \text{Fixed costs}}{\text{Break-even units}}$$
$$= \frac{\$200,000 - \$80,000}{25,000} = \frac{\$120,000}{25,000} = \$4.80/\text{unit}.$$
3. Selling price/unit =
$$\frac{\text{Break-even sales}}{\text{Break-even units}} = \frac{\$200,000}{25,000} = \$8.00/\text{unit}.$$

Firm B

1. Fixed costs = \$120,000.
2. Variable cost/unit =
$$\frac{\text{Break-even sales} - \text{Fixed costs}}{\text{Break-even units}}$$
$$= \frac{\$240,000 - \$120,000}{30,000} = \$4.00/\text{unit}.$$
3. Selling price/unit =
$$\frac{\text{Break-even sales}}{\text{Break-even units}} = \frac{\$240,000}{30,000} = \$8.00/\text{unit}.$$

- b. Firm B has the higher operating leverage due to its larger amount of fixed costs.
- c. Operating profit = (Selling price)(Units sold) – Fixed costs – (Variable costs/unit)(Units sold).

Firm A's operating profit = $\$8X - \$80,000 - \$4.80X$.

Firm B's operating profit = $\$8X - \$120,000 - \$4.00X$.

Set the two equations equal to each other:

$$\begin{aligned}\$8X - \$80,000 - \$4.80X &= \$8X - \$120,000 - \$4.00X \\ -\$0.8X &= -\$40,000 \\ X &= \$40,000/\$0.80 = 50,000 \text{ units.}\end{aligned}$$

Sales level = (Selling price)(Units) = $\$8(50,000) = \$400,000$.

At this sales level, both firms earn \$80,000:

$$\begin{aligned}\text{Profit}_A &= \$8(50,000) - \$80,000 - \$4.80(50,000) \\ &= \$400,000 - \$80,000 - \$240,000 = \$80,000.\end{aligned}$$

$$\begin{aligned}\text{Profit}_B &= \$8(50,000) - \$120,000 - \$4.00(50,000) \\ &= \$400,000 - \$120,000 - \$200,000 = \$80,000.\end{aligned}$$

15-13 a. Using the standard formula for the weighted average cost of capital, we find:

$$\begin{aligned} \text{WACC} &= w_d r_d (1 - T) + w_e r_s \\ &= (0.2)(8\%)(1 - 0.4) + (0.8)(12.5\%) \\ &= 10.96\%. \end{aligned}$$

b. The firm's current levered beta at 20% debt can be found using the CAPM formula.

$$\begin{aligned} r_s &= r_{RF} + (r_M - r_{RF})b \\ 12.5\% &= 5\% + (6\%)b \\ b &= 1.25. \end{aligned}$$

c. To "unlever" the firm's beta, the Hamada equation is used.

$$\begin{aligned} b_L &= b_U [1 + (1 - T)(D/E)] \\ 1.25 &= b_U [1 + (1 - 0.4)(0.2/0.8)] \\ 1.25 &= b_U (1.15) \\ b_U &= 1.086957. \end{aligned}$$

d. To determine the firm's new cost of common equity, one must find the firm's new beta under its new capital structure. Consequently, you must "relever" the firm's beta using the Hamada equation:

$$\begin{aligned} b_{L,40\%} &= b_U [1 + (1 - T)(D/E)] \\ b_{L,40\%} &= 1.086957 [1 + (1 - 0.4)(0.4/0.6)] \\ b_{L,40\%} &= 1.086957(1.4) \\ b_{L,40\%} &= 1.521739. \end{aligned}$$

The firm's cost of equity, as stated in the problem, is derived using the CAPM equation.

$$\begin{aligned} r_s &= r_{RF} + (r_M - r_{RF})b \\ r_s &= 5\% + (6\%)1.521739 \\ r_s &= 14.13\%. \end{aligned}$$

e. Again, the standard formula for the weighted average cost of capital is used. Remember, the WACC is a marginal, after-tax cost of capital and hence the relevant before-tax cost of debt is now 9.5% and the cost of equity is 14.13%.

$$\begin{aligned} \text{WACC} &= w_d r_d (1 - T) + w_e r_s \\ &= (0.4)(9.5\%)(1 - 0.4) + (0.6)(14.13\%) \\ &= 10.76\%. \end{aligned}$$

f. The firm should be advised to proceed with the recapitalization as it causes the WACC to decrease from 10.96% to 10.76%. As a result, the recapitalization would lead to an increase in firm value.

15-14 a. Without new investment:

Sales	\$12,960,000
VC	10,200,000
FC	<u>1,560,000</u>
EBIT	\$ 1,200,000
Interest	<u>384,000*</u>
EBT	\$ 816,000
Tax (40%)	<u>326,400</u>

Net income \$ 489,600

*Interest = 0.08(\$4,800,000) = \$384,000.

$$1. \text{ EPS}_{\text{Old}} = \$489,600/240,000 = \$2.04.$$

With new investment:

	<u>Debt</u>	<u>Stock</u>
Sales	\$12,960,000	\$12,960,000
VC (0.8)(\$10,200,000)	8,160,000	8,160,000
FC	<u>1,800,000</u>	<u>1,800,000</u>
EBIT	\$ 3,000,000	\$ 3,000,000
Interest	<u>1,104,000**</u>	<u>384,000</u>
EBT	\$ 1,896,000	\$ 2,616,000
Tax (40%)	<u>758,400</u>	<u>1,046,400</u>
Net income	<u>\$ 1,137,600</u>	<u>\$ 1,569,600</u>

**Interest = 0.08(\$4,800,000) + 0.10(\$7,200,000) = \$1,104,000.

$$2. \text{ EPS}_D = \$1,137,600/240,000 = \$4.74.$$

$$3. \text{ EPS}_S = \$1,569,600/480,000 = \$3.27.$$

EPS should improve, but expected EPS is significantly higher if financial leverage is used.

$$\begin{aligned} \text{b. } \text{EPS} &= \frac{(\text{Sales} - \text{VC} - \text{F} - \text{I})(1 - \text{T})}{\text{N}} \\ &= \frac{(\text{PQ} - \text{VQ} - \text{F} - \text{I})(1 - \text{T})}{\text{N}}. \end{aligned}$$

$$\begin{aligned} \text{EPS}_{\text{Debt}} &= \frac{(\$28.8\text{Q} - \$18.133\text{Q} - \$1,800,000 - \$1,104,000)(0.6)}{240,000} \\ &= \frac{(\$10.667\text{Q} - \$2,904,000)(0.6)}{240,000}. \end{aligned}$$

$$\text{EPS}_{\text{Stock}} = \frac{(\$10.667\text{Q} - \$2,184,000)(0.6)}{480,000}.$$

Therefore,

$$\begin{aligned} \frac{(\$10.667\text{Q} - \$2,184,000)(0.6)}{480,000} &= \frac{(\$10.667\text{Q} - \$2,904,000)(0.6)}{240,000} \\ \$10.667\text{Q} &= \$3,624,000 \\ \text{Q} &= 339,750 \text{ units.} \end{aligned}$$

This is the "indifference" sales level, where $\text{EPS}_{\text{debt}} = \text{EPS}_{\text{stock}}$.

$$\text{c. } \text{EPS}_{\text{Old}} = \frac{(\$28.8\text{Q} - \$22.667\text{Q} - \$1,560,000 - \$384,000)(0.6)}{240,000} = 0$$

$$\begin{aligned} \$6.133\text{Q} &= \$1,944,000 \\ \text{Q} &= 316,957 \text{ units.} \end{aligned}$$

This is the Q_{BE} considering interest charges.

$$EPS_{New,Debt} = \frac{(\$28.8Q - \$18.133Q - \$2,904,000)(0.6)}{240,000} = 0$$

$$\begin{aligned} \$10.667Q &= \$2,904,000 \\ Q &= 272,250 \text{ units.} \end{aligned}$$

$$EPS_{New,Stock} = \frac{(\$10.667Q - \$2,184,000)(0.6)}{480,000} = 0$$

$$\begin{aligned} \$10.667Q &= \$2,184,000 \\ Q &= 204,750 \text{ units.} \end{aligned}$$

- d. At the expected sales level, 450,000 units, we have these EPS values:

$$EPS_{Old\ Setup} = \$2.04. \quad EPS_{New,Debt} = \$4.74. \quad EPS_{New,Stock} = \$3.27.$$

We are given that operating leverage is lower under the new setup. Accordingly, this suggests that the new production setup is less risky than the old one—variable costs drop very sharply, while fixed costs rise less, so the firm has lower costs at “reasonable” sales levels.

In view of both risk and profit considerations, the new production setup seems better. Therefore, the question that remains is how to finance the investment.

The indifference sales level, where $EPS_{debt} = EPS_{stock}$, is 339,750 units. This is well below the 450,000 expected sales level. If sales fall as low as 250,000 units, these EPS figures would result:

$$EPS_{Debt} = \frac{[\$28.8(250,000) - \$18.133(250,000) - \$2,904,000](0.6)}{240,000} = -\$0.59.$$

$$EPS_{Stock} = \frac{[\$28.8(250,000) - \$18.133(250,000) - \$2,184,000](0.6)}{480,000} = \$0.60.$$

These calculations assume that P and V remain constant, and that the company can obtain tax credits on losses. Of course, if sales rose above the expected 450,000 level, EPS would soar if the firm used debt financing.

In the “real world” we would have more information on which to base the decision—coverage ratios of other companies in the industry and better estimates of the likely range of unit sales. On the basis of the information at hand, we would probably use equity financing, but the decision is really not obvious.

15-15 Use of debt (millions of dollars):

Probability	0.3	0.4	0.3
Sales	\$2,250.00	\$2,700.00	\$3,150.00
EBIT (10% of sales)	225.00	270.00	315.00
Interest*	<u>117.15</u>	<u>117.15</u>	<u>117.15</u>
EBT	\$ 107.85	\$ 152.85	\$ 197.85
Taxes (40%)	<u>43.14</u>	<u>61.14</u>	<u>79.14</u>
Net income	<u>\$ 64.71</u>	<u>\$ 91.71</u>	<u>\$ 118.71</u>
Earnings per share (20 million shares)	<u>\$3.24</u>	<u>\$4.59</u>	<u>\$5.94</u>

*Interest on debt = $(\$270 \times 0.12) + \text{Current interest expense}$
 $= \$32.4 + \$84.75 = \$117.15.$

Expected EPS = $(0.30)(\$3.24) + (0.40)(\$4.59) + (0.30)(\$5.94)$
 $= \$4.59 \text{ if debt is used.}$

$$\sigma_{\text{Debt}}^2 = (0.30)(\$3.24 - \$4.59)^2 + (0.40)(\$4.59 - \$4.59)^2 + (0.30)(\$5.94 - \$4.59)^2 = 1.094.$$

Standard deviation of EPS if debt financing is used:

$$\sigma_{\text{Debt}} = \sqrt{1.094} = \$1.05.$$

$$CV = \frac{\$1.05}{\$4.59} = 0.23.$$

$$E(\text{TIE}_{\text{Debt}}) = \frac{E(\text{EBIT})}{I} = \frac{\$270}{\$117.15} = 2.30\times.$$

$$\text{Debt/Total capital} = (\$255.00 + \$697.50 + \$270)/(\$255.00 + \$697.50 + \$397.50 + \$270) \\ = 75.5\%.$$

Use of stock (millions of dollars):

Probability	0.3	0.4	0.3
Sales	\$2,250.00	\$2,700.00	\$3,150.00
EBIT (10% of sales)	225.00	270.00	315.00
Interest	<u>84.75</u>	<u>84.75</u>	<u>84.75</u>
EBT	\$ 140.25	\$ 185.25	\$ 230.25
Taxes (40%)	<u>56.10</u>	<u>74.10</u>	<u>92.10</u>
Net income	<u>\$ 84.15</u>	<u>\$ 111.15</u>	<u>\$ 138.15</u>
Earnings per share (24.5 million shares)*	<u>\$3.43</u>	<u>\$4.54</u>	<u>\$5.64</u>

*Number of shares = $(\$270 \text{ million}/\$60) + 20 \text{ million}$
 $= 4.5 \text{ million} + 20 \text{ million} = 24.5 \text{ million.}$

$$\text{EPS}_{\text{Equity}} = (0.30)(\$3.43) + (0.40)(\$4.54) + (0.30)(\$5.64) = \$4.54.$$

$$\sigma_{\text{Equity}}^2 = (0.30)(\$3.43 - \$4.54)^2 + (0.40)(\$4.54 - \$4.54)^2 + (0.30)(\$5.64 - \$4.54)^2 = 0.7326.$$

$$\sigma_{\text{Equity}} = \sqrt{0.7326} = \$0.86.$$

$$CV = \frac{\$0.86}{\$4.54} = 0.19.$$

$$E(TIE_{\text{Stock}}) = \frac{\$270}{\$84.75} = 3.19\times.$$

$$\frac{\text{Debt}}{\text{Total capital}} = \frac{\$2.55.00 + \$697.50}{\$255.00 + \$697.50 + \$397.50 + \$270} = \frac{\$952.50}{\$1,620.00} = 58.8\%.$$

Under debt financing the expected EPS is \$4.59, the standard deviation is \$1.05, the CV is 0.23, and the debt-to-capital ratio increases to 75.5%. (The debt-to-capital ratio had been 70.6%.) Under equity financing the expected EPS is \$4.54, the standard deviation is \$0.86, the CV is 0.19, and the debt-to-capital ratio decreases to 58.8%. At this interest rate, debt financing provides a slightly higher expected EPS than equity financing; however, the debt-to-capital ratio is significantly higher under the debt financing situation as compared with the equity financing situation. Because EPS is not significantly greater under debt financing compared to equity financing, while the risk is noticeably greater, equity financing should be recommended.

Comprehensive/Spreadsheet Problem

Note to Instructors:

The solution to this problem is not provided to students at the back of their text. Instructors can access the *Excel* file on the textbook's website.

15-16 Tax rate = 40%; $r_{RF} = 5.0\%$; $b_U = 1.2$; $r_M - r_{RF} = 6.0\%$

From data given in the problem and table we can develop the following table:

w_d	w_c	D/E	r_d	$r_d(1 - T)$	Levered beta ^a	r_s ^b	WACC ^c
0.00	1.00	0.0000	7.00%	4.20%	1.20	12.20%	12.20%
0.20	0.80	0.2500	8.00	4.80	1.38	13.28	11.58
0.40	0.60	0.6667	10.00	6.00	1.68	15.08	11.45
0.60	0.40	1.5000	12.00	7.20	2.28	18.68	11.79
0.80	0.20	4.0000	15.00	9.00	4.08	29.48	13.10

Notes:

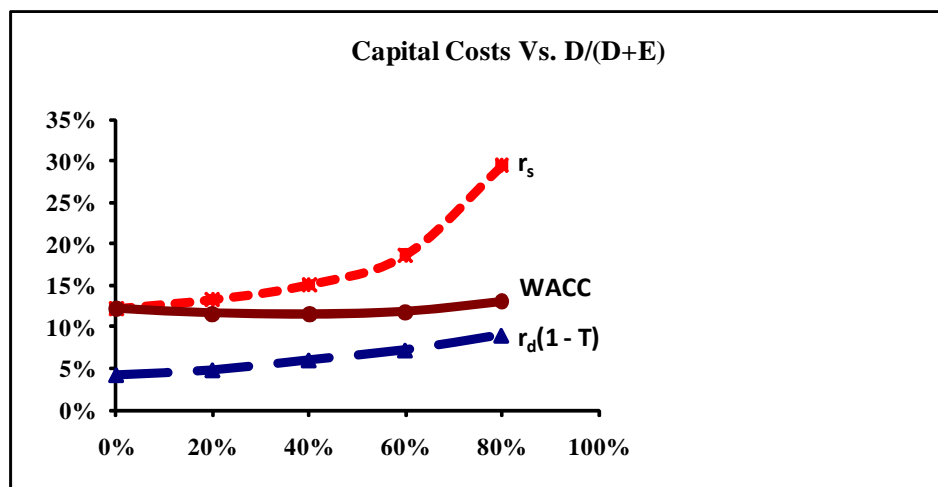
^a These beta estimates were calculated using the Hamada equation, $b_L = b_U[1 + (1 - T)(D/E)]$.

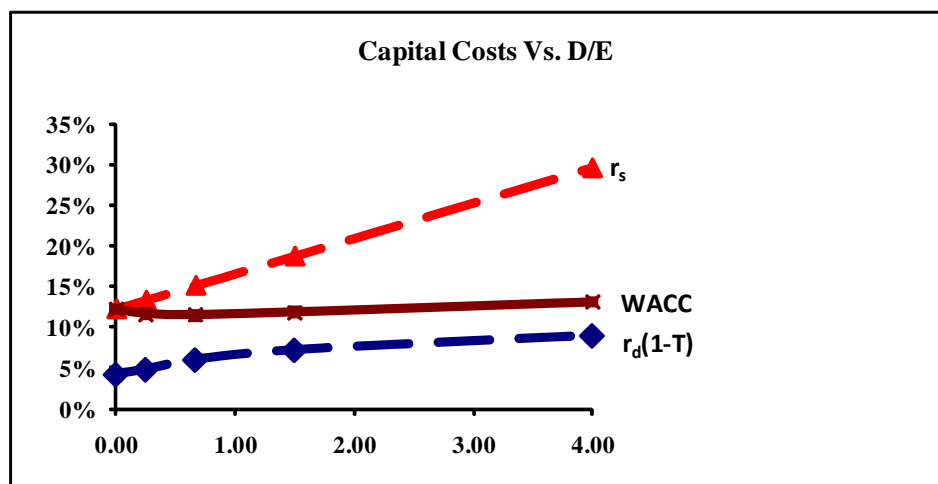
^b These r_s estimates were calculated using the CAPM, $r_s = r_{RF} + (r_M - r_{RF})b$.

^c These WACC estimates were calculated with the following equation: $WACC = w_d(r_d)(1 - T) + (w_c)(r_s)$.

- The firm's optimal capital structure is that capital structure which minimizes the firm's WACC. Eden's WACC is minimized at a capital structure consisting of 40% debt and 60% equity. At that capital structure, the firm's WACC is 11.45%.
- If the firm's business risk increased, the firm's target capital structure would consist of less debt and more equity.
- If the ministry of finance dramatically increases the corporate tax rate, then the tax deductibility of interest would be greater the higher the tax rate. This should lead to an increase in the firm's use of debt in its capital structure.

d.





The top graph is like the one in the textbook, because it uses the $D/(D + E)$ ratio on the horizontal axis. The bottom graph is a bit like MM showed in their original article in that the cost of equity is linear and the WACC does not turn up sharply. It is not exactly like MM because it uses $D/(D + E)$ rather than D/V , and also because MM assumed that r_d is constant whereas we assume the cost of debt rises with leverage.

Note too that the minimum WACC is at the $D/(D + E)$ and D/E levels indicated in the table, and also that the WACC curve is very flat over a broad range of debt ratios, indicating that WACC is not sensitive to debt over a broad range. This is important, as it demonstrates that management can use a lot of discretion as to its capital structure, and that it is OK to alter the debt ratio to take advantage of market conditions in the debt and equity markets, and to increase the debt ratio if many good investment opportunities are available.

Integrated Case

15-17

Cheetah Cafe Company ***Optimal Capital Structure***

Assume that you have just been hired as business manager of Cheetah Cafe (CC), which is located adjacent to the campus of Universiti Putra Malaysia. Sales were \$1,100,000 last year, variable costs were 60% of sales, and fixed costs were \$40,000. Therefore, EBIT totaled \$400,000. Because the university's enrollment is capped, EBIT is expected to be constant over time. Because no expansion capital is required, CC distributes all earnings as dividends. Invested capital is \$2 million, and 80,000 shares are outstanding. The management group owns about 50% of the stock, which is traded in the over-the-counter market.

CC currently has no debt—it is an all-equity firm—and its 80,000 shares outstanding sell at a price of \$25 per share, which is also the book value. The firm's corporate tax rate is 40%. On the basis of statements made in your finance text, you believe that CC's shareholders would be better off if some debt financing was used. When you suggested this to your new boss, she encouraged you to pursue the idea but to provide support for the suggestion.

In today's market, the risk-free rate, r_{RF} , is 6% and the market risk premium, RP_M , is 6%. CC's unlevered beta, b_U , is 1.0. CC currently has no debt, so its cost of equity (and WACC) is 12%. If the firm was recapitalized, debt would be issued and the borrowed funds would be used to repurchase stock. Stockholders, in turn, would use funds provided by the repurchase to buy equities in other companies similar to CC. You plan to complete your report by asking and then answering the following questions.

A. (1) What is business risk? What factors influence a firm's business risk?

Answer: [Show S15-1 through S15-3 here.] Business risk is the riskiness inherent in the firm's operations if it uses no debt. A firm's business risk is affected by many factors, including these: (1) variability in the demand for its output, (2) variability in the price at which its output can be sold, (3) variability in the prices of its inputs, (4) the firm's ability to adjust output prices as input prices change, (5) the amount of operating leverage used by the firm, and (6) special risk factors (such as potential product liability for a drug company or the potential cost of a nuclear accident for a utility with nuclear plants).

A. (2) What is operating leverage, and how does it affect a firm's business risk?

Answer: [Show S15-4 through S15-6 here.] Operating leverage is the extent to which fixed costs are used in a firm's operations. If a high percentage of the firm's total costs are fixed, and hence do not decline when demand falls, then the firm is said to have high operating leverage. Other things held constant, the greater a firm's operating leverage, the greater its business risk.

A. (3) What is the firm's return on invested capital (ROIC)?

Answer: [Show S15-7 here.]

$$\begin{aligned}\text{ROIC} &= \frac{\text{EBIT}(1 - T)}{\text{Investor-supplied capital}} \\ &= \frac{\$400,000(0.6)}{\$2,000,000} \\ &= 12\%.\end{aligned}$$

B. (1) What do the terms financial leverage and financial risk mean?

Answer: [Show S15-8 here.] Financial leverage refers to the firm's decision to finance with fixed-income securities, such as debt and preferred stock. Financial risk is the additional risk, over and above the company's inherent business risk, borne by the stockholders as a result of the firm's decision to finance with debt.

B. (2) How does financial risk differ from business risk?

Answer: [Show S15-9 here.] As we discussed above, business risk depends on a number of factors such as sales and cost variability, and operating leverage. Financial risk, on the other hand, depends on only one factor—the amount of fixed-income capital the company uses.

C. To develop an example that can be presented to CC's management as an illustration, consider two hypothetical firms: Firm U with zero debt financing and Firm L with \$10,000 of 12% debt. Both firms have \$20,000 in invested capital and a 40% corporate tax rate, and they have the following EBIT probability distribution for next year:

<u>Probability</u>	<u>EBIT</u>
0.25	\$2,000
0.50	3,000
0.25	4,000

(1) Complete the partial income statements and the firms' ratios in Table IC 15.1.

Table IC 15.1. Income Statements and Ratios

	Firm U			Firm L		
Total capital	\$20,000	\$20,000	\$20,000	\$20,000	\$20,000	\$20,000
Equity	\$20,000	\$20,000	\$20,000	\$10,000	\$10,000	\$10,000
Probability	0.25	0.50	0.25	0.25	0.50	0.25
Sales	\$ 6,000	\$ 9,000	\$12,000	\$ 6,000	\$ 9,000	\$12,000
Oper. costs	<u>4,000</u>	<u>6,000</u>	<u>8,000</u>	<u>4,000</u>	<u>6,000</u>	<u>8,000</u>
EBIT	\$ 2,000	\$ 3,000	\$ 4,000	\$ 2,000	\$ 3,000	\$ 4,000
Int. (12%)	<u>0</u>	<u>0</u>	<u>0</u>	<u>1,200</u>		<u>1,200</u>
EBT	\$ 2,000	\$ 3,000	\$ 4,000	\$ 800	\$	\$ 2,800
Taxes (40%)	<u>800</u>	<u>1,200</u>	<u>1,600</u>	<u>320</u>		<u>1,120</u>
Net income	<u>\$ 1,200</u>	<u>\$ 1,800</u>	<u>\$ 2,400</u>	<u>\$ 480</u>	<u>\$</u>	<u>\$ 1,680</u>
ROIC	6.0%	9.0%	12.0%	%	%	%
ROE	6.0%	9.0%	12.0%	4.8%	%	16.8%
TIE	∞	∞	∞	1.7x	x	3.3x
E(ROIC)		9.0%			%	
E(ROE)		9.0%			10.8%	
E(TIE)		∞			2.5x	
σ_{ROIC}		2.1%			%	
σ_{ROE}		2.1%			4.2%	
σ_{TIE}		0			0.6x	

Answer: [Show S15-10 through S15-13 here.] Here are the fully completed statements:

	Firm U			Firm L		
Total capital	\$20,000	\$20,000	\$20,000	\$20,000	\$20,000	\$20,000
Equity	\$20,000	\$20,000	\$20,000	\$10,000	\$10,000	\$10,000
Probability	0.25	0.50	0.25	0.25	0.50	0.25
EBIT	\$ 2,000	\$ 3,000	\$ 4,000	\$ 2,000	\$ 3,000	\$ 4,000
Int. (12%)	<u>0</u>	<u>0</u>	<u>0</u>	<u>1,200</u>	<u>1,200</u>	<u>1,200</u>
EBT	\$ 2,000	\$ 3,000	\$ 4,000	\$ 800	\$ 1,800	\$ 2,800
Taxes (40%)	<u>800</u>	<u>1,200</u>	<u>1,600</u>	<u>320</u>	<u>720</u>	<u>1,120</u>
Net income	<u>\$ 1,200</u>	<u>\$ 1,800</u>	<u>\$ 2,400</u>	<u>\$ 480</u>	<u>\$ 1,080</u>	<u>\$ 1,680</u>
ROIC	6.0%	9.0%	12.0%	6.0%	9.0%	12.0%
ROE	6.0%	9.0%	12.0%	4.8%	10.8%	16.8%
TIE	∞	∞	∞	1.7x	2.5x	3.3x
E(ROIC)		9.0%			9.0%	
E(ROE)		9.0%			10.8%	
E(TIE)		∞			2.5x	
σ_{ROIC}		2.1%			2.1%	
σ_{ROE}		2.1%			4.2%	
σ_{TIE}		0			0.6x	

C. (2) Be prepared to discuss each entry in the table and to explain how this example illustrates the effect of financial leverage on expected rate of return and risk.

Answer: [Show S15-14 through S15-16 here.] Conclusions from the analysis:

1. The firm's ROIC, $ROIC = EBIT(1 - T)/\text{Investor-supplied capital}$, is unaffected by financial leverage.
2. Firm L has the higher expected ROE:

$$E(ROE_U) = 0.25(6.0\%) + 0.50(9.0\%) + 0.25(12.0\%) = 9.0\%.$$

$$E(ROE_L) = 0.25(4.8\%) + 0.50(10.8\%) + 0.25(16.8\%) = 10.8\%.$$

Therefore, the use of financial leverage has increased the expected profitability to shareholders. Tax savings cause the higher expected ROE_L . (If the firm uses debt, the stock is riskier, which then causes r_d and r_s to increase. With a higher r_d , interest increases, so the interest tax savings increases.)

3. Firm L has a wider range of ROEs, and a higher standard deviation of ROE, indicating that its higher expected return is accompanied by higher risk. To be precise:

$$\sigma_{ROE \text{ (Unlevered)}} = 2.12\%, \text{ and } CV = 0.24.$$

$$\sigma_{ROE \text{ (Levered)}} = 4.24\%, \text{ and } CV = 0.39.$$

Thus, in a stand-alone risk sense, Firm L is twice as risky as Firm U—its business risk is 2.12%, but its stand-alone risk is 4.24%, so its financial risk is $4.24\% - 2.12\% = 2.12\%$.

4. When $EBIT = \$2,000$, $ROE_U > ROE_L$, and leverage has a negative impact on profitability. However, at the expected level of EBIT, $ROE_L > ROE_U$.
5. Leverage will always boost expected ROE if expected ROIC exceeds the after-tax cost of debt. Here $E(ROIC) = 9.0\% > r_d(1 - T) = 12\%(0.6) = 7.2\%$, so the use of debt raises expected ROE.
6. Finally, note that the TIE ratio is huge (undefined, or infinitely large) if no debt is used, but it is relatively low if 50% debt is used. The expected TIE would be larger than 2.5× if less debt were used, but smaller if leverage were increased.

D. After speaking with a local investment banker, you obtain the following estimates of the cost of debt at different debt levels (in thousands of dollars):

<u>Amount Borrowed</u>	<u>Debt/Capital Ratio</u>	<u>Debt/Equity Ratio</u>	<u>Bond Rating</u>	<u>r_d</u>
\$ 0	0.000	0.0000	—	—
250	0.125	0.1429	AA	8.0%
500	0.250	0.3333	A	9.0
750	0.375	0.6000	BBB	11.5
1,000	0.500	1.0000	BB	14.0

Now consider the optimal capital structure for CC.

- (1) To begin, define the terms optimal capital structure and target capital structure.

Answer: [Show S15-17 here.] The optimal capital structure is the capital structure at which the tax-related benefits of leverage are exactly offset by debt's risk-related costs. At the optimal capital structure, (1) the total value of the firm is maximized, (2) the WACC is minimized, and the price per share is maximized. The target capital structure is the mix of debt, preferred stock, and common equity with which the firm plans to raise capital.

- D. (2) Why does CC's bond rating and cost of debt depend on the amount of money borrowed?

Answer: [Show S15-18 here.] 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 a firm's operations. If a firm uses debt (financial leverage), this concentrates the business risk on common stockholders.

Financing with debt increases the expected rate of return for an investment, but leverage also increases the probability of a large

loss, thus increasing the risk borne by stockholders. As the amount of money borrowed increases, the firm increases its risk so the firm's bond rating decreases and its cost of debt increases.

- D. (3) Assume that shares could be repurchased at the current market price of \$25 per share. Calculate CC's expected EPS and TIE at debt levels of \$0, \$250,000, \$500,000, \$750,000, and \$1,000,000. How many shares would remain after recapitalization under each scenario?

Answer: [Show S15-19 through S15-25 here.] The analysis for the debt levels being considered (in thousands of dollars and shares) is shown below:

At D = \$0:

$$\text{EPS} = \frac{[\text{EBIT} - r_d(D)](1 - T)}{\text{Shares outstanding}} = \frac{\$400,000(0.6)}{80,000} = \$3.00.$$

$$\text{TIE} = \frac{\text{EBIT}}{\text{Interest}} = \infty.$$

At D = \$250,000:

$$\text{Shares repurchased} = \$250,000 / \$25 = 10,000.$$

$$\text{Remaining shares outstanding} = 80,000 - 10,000 = 70,000.$$

(Note: EPS and TIE calculations are in thousands of dollars.)

$$\text{EPS} = \frac{[\$400 - 0.08(\$250)](0.6)}{70} = \$3.26.$$

$$\text{TIE} = \frac{\$400}{\$20} = 20\times.$$

At D = \$500,000:

$$\text{Shares repurchased} = \$500,000 / \$25 = 20,000.$$

$$\text{Remaining shares outstanding} = 80,000 - 20,000 = 60,000.$$

(Note: EPS and TIE calculations are in thousands of dollars.)

$$\text{EPS} = \frac{[\$400 - 0.09(\$500)](0.6)}{60} = \$3.55.$$

$$\text{TIE} = \frac{\$400}{\$45} = 8.9\times.$$

At D = \$750,000:

$$\text{Shares repurchased} = \$750,000/\$25 = 30,000.$$

$$\text{Remaining shares outstanding} = 80,000 - 30,000 = 50,000.$$

(Note: EPS and TIE calculations are in thousands of dollars.)

$$\text{EPS} = \frac{[\$400 - 0.115(\$750)](0.60)}{50} = \$3.77.$$

$$\text{Tie} = \frac{\$400}{\$86.25} = 4.6\times.$$

At D = \$1,000,000:

$$\text{Shares repurchased} = \$1,000,000/\$25 = 40,000.$$

$$\text{Remaining shares outstanding} = 80,000 - 40,000 = 40,000.$$

(Note: EPS and TIE calculations are in thousands of dollars.)

$$\text{EPS} = \frac{[\$400 - 0.14(\$1,000)](0.60)}{40} = \$3.90.$$

$$\text{TIE} = \frac{\$400}{\$140} = 2.9\times.$$

- D. (4) Using the Hamada equation, what is the cost of equity if CC recapitalizes with \$250,000 of debt? \$500,000? \$750,000? \$1,000,000?

Answer: [Show S15-26 through S15-30 here.]

$$r_{RF} = 6.0\%$$

$$b_U = 1.0$$

$$\text{Tax rate} = 40.0\%$$

$$r_M - r_{RF} = 6.0\%$$

$$\text{Total capital} = \$2,000$$

<u>Amount Borrowed^a</u>	<u>Debt/Capital Ratio^b</u>	<u>Debt/Equity Ratio^c</u>	<u>Levered Beta^d</u>	<u>r_s^e</u>
\$ 0	0.00%	0.00%	1.00	12.00%
250	12.50	14.29	1.09	12.51
500	25.00	33.33	1.20	13.20
750	37.50	60.00	1.36	14.16
1,000	50.00	100.00	1.60	15.60

Notes:

^a Data given in problem.

^b Calculated as amount borrowed divided by total capital.

^c Calculated as amount borrowed divided by equity (total capital less amount borrowed).

^d Calculated using the Hamada equation, $b_L = b_U[1 + (1 - T)(D/E)]$.

^e Calculated using the CAPM, $r_s = r_{RF} + (r_M - r_{RF})b$, given the risk-free rate, the market risk premium, and using the levered beta as calculated with the Hamada equation.

D. (5) Considering only the levels of debt discussed, what is the capital structure that minimizes CC's WACC?

Answer: [Show S15-31 and S15-32 here.]

$$r_{RF} = 6.0\%$$

$$b_U = 1.0$$

$$\text{Tax rate} = 40.0\%$$

$$r_M - r_{RF} = 6.0\%$$

$$\text{Total capital} = \$2,000$$

Amount Borrowed ^a	Debt/Capital Ratio ^b	Equity/Capital Ratio ^c	Debt/Equity Ratio ^d	Levered Beta ^e	r_s^f	r_d^a	$r_d(1 - T)$	WACC ^g
\$ 0	0.00%	100.00%	0.00%	1.00	12.00%	0.0%	0.0%	12.00%
250	12.50	87.50	14.29	1.09	12.51	8.0	4.8	11.55
500	25.00	75.00	33.33	1.20	13.20	9.0	5.4	11.25
750	37.50	62.50	60.00	1.36	14.16	11.5	6.9	11.44
1,000	50.00	50.00	100.00	1.60	15.60	14.0	8.4	12.00

Notes:

^a Data given in problem.

^b Calculated as amount borrowed divided by total capital.

^c Calculated as $1 - D/(D + E)$.

^d Calculated as amount borrowed divided by equity (total capital less amount borrowed).

^e Calculated using the Hamada equation, $b_L = b_U[1 + (1 - T)(D/E)]$.

^f Calculated using the CAPM, $r_s = r_{RF} + (r_M - r_{RF})b$, given the risk-free rate, the market risk premium, and using the levered beta as calculated with the Hamada equation.

^g Calculated using the WACC equation, $WACC = w_d r_d(1 - T) + w_e r_s$.

CD's WACC is minimized at a capital structure that consists of 25% debt and 75% equity, or a WACC of 11.25%.

D. (6) What would be the new stock price if CC recapitalizes with \$250,000 of debt? \$500,000? \$750,000? \$1,000,000? Recall that the payout ratio is 100%, so $g = 0$.

Answer: [Show S15-33 and S15-34 here.] We can calculate the price of a constant growth stock as DPS divided by r_s minus g , where g is the expected growth rate in dividends: $P_0 = D_1/(r_s - g)$. Since in this

case all earnings are paid out to the stockholders, $DPS = EPS$. Further, because no earnings are plowed back, the firm's EBIT is not expected to grow, so $g = 0$.

Here are the results:

<u>Debt Level</u>	<u>DPS</u>	<u>r_s</u>	<u>Stock Price</u>
\$ 0	\$3.00	12.00%	\$25.00
250,000	3.26	12.51	26.03
500,000	3.55	13.20	26.89*
750,000	3.77	14.16	26.59
1,000,000	3.90	15.60	25.00

*Maximum

D. (7) Is EPS maximized at the debt level that maximizes share price? Why or why not?

Answer: [Show S15-35 here.] We have seen that EPS continues to increase beyond the \$500,000 optimal level of debt. Therefore, focusing on EPS when making capital structure decisions is not correct—while the EPS does take account of the differential cost of debt, it does not account for the increasing risk that must be borne by the equity holders.

D. (8) Considering only the levels of debt discussed, what is CC's optimal capital structure?

Answer: [Show S15-36 here.] A capital structure with \$500,000 of debt produces the highest stock price, \$26.89; hence, it is the best of those considered.

D. (9) What is the WACC at the optimal capital structure?

Answer: Initial debt level:

Debt/Total capital = 0%, so Total capital = Initial equity = \$25 × 80,000 shares = \$2,000,000.

$$\begin{aligned} \text{WACC} &= \left(\frac{\$500,000}{\$2,000,000} \right) (9\%) (0.60) + \left(\frac{\$1,500,000}{\$2,000,000} \right) (13.2\%) \\ &= 1.35\% + 9.90\% = 11.25\%. \end{aligned}$$

Note: If we had (1) used the equilibrium price for repurchasing shares and (2) used market value weights to calculate WACC, then we could be sure that the WACC at the price-maximizing capital structure would be the minimum. Using a constant \$25 purchase price, and book value weights, inconsistencies may creep in.

E. Suppose you discovered that CC had more business risk than you originally estimated. Describe how this would affect the analysis. How would the analysis be affected if the firm had less business risk than originally estimated?

Answer: [Show S15-37 here.] If the firm had higher business risk, then, at any debt level, its probability of financial distress would be higher. Investors would recognize this, and both r_d and r_s would be higher than originally estimated. It is not shown in this analysis, but the end result would be an optimal capital structure with less debt. Conversely, lower business risk would lead to an optimal capital structure that included more debt.

F. What are some factors a manager should consider when establishing his or her firm's target capital structure?

Answer: [Show S15-38 here.] Since it is difficult to quantify the capital structure decision, managers consider the following judgmental factors when making capital structure decisions:

1. The average debt ratio for firms in their industry.
2. Pro forma TIE ratios at different capital structures under different scenarios.
3. Lender/rating agency attitudes.
4. Reserve borrowing capacity.
5. Effects of financing on control.
6. Asset structure.
7. Expected tax rate.
8. Management attitudes.
9. Market conditions.
10. Firm's internal conditions.
11. Firm's operating leverage.
12. Firm's growth rate.
13. Firm's profitability.

Optional Question

Modigliani and Miller proved, under a very restrictive set of assumptions, that the value of a firm will be maximized by financing almost entirely with debt.

Why, according to MM, is debt beneficial?

Answer: MM argued that using debt increases the value of the firm because interest is tax deductible. The government, in effect, pays part of the interest, and this lowers the cost of debt relative to the cost of equity, making debt financing more attractive than equity financing. Put another way, since interest is deductible, the more debt a company uses, the lower its tax bill, and the more of its operating income flows through to investors, so the greater its value.

Optional Question

What assumptions underlie the MM theory? Are these assumptions realistic?

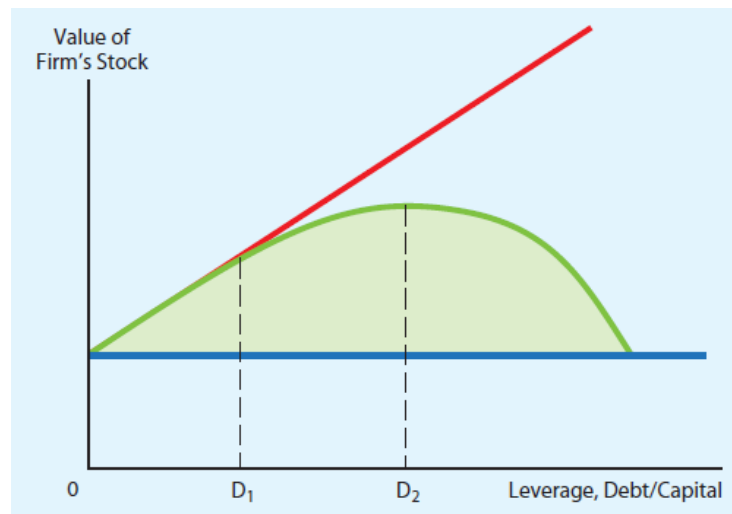
Answer: MM's key assumptions are as follows:

- 1. There are no brokerage costs.**
- 2. There are no taxes.**
- 3. Investors can borrow at the same rate as corporations.**
- 4. Investors have the same information as managers about the firm's future investment opportunities.**
- 5. All of the firm's debt is riskless, regardless of how much it uses. (There are no bankruptcy costs.)**
- 6. EBIT is not affected by the use of debt.**

These assumptions are obviously unrealistic—investors do incur brokerage fees and personal income taxes; they cannot borrow at

the same rate as corporations; and they do not have the same information as the firm's managers regarding future investment opportunities. Also, corporate debt is risky, especially if a firm uses lots of debt, and the interest rate will rise as the debt level increases.

Figure IC 15.1. Relationship between Capital Structure and Stock Price



G. Put labels on Figure IC 15.1 and then discuss the graph as you might use it to explain to your boss why CC might want to use some debt.

Answer: [Show S15-39 and S15-40 here.] The use of debt permits a firm to obtain tax savings from the deductibility of interest. So the use of some debt is good; however, the possibility of bankruptcy increases the cost of using debt. At higher and higher levels of debt, the risk of bankruptcy increases, bringing with it costs associated with potential financial distress. Customers reduce purchases, key employees leave, and so on. There is some point, generally well below a debt ratio of 100%, at which problems associated with potential bankruptcy more than offset the tax savings from debt.

Theoretically, the optimal capital structure is found at the point where the marginal tax savings just equal the marginal bankruptcy-related costs. However, analysts cannot identify this point with precision for any given firm, or for firms in general. Analysts can help managers determine an optimal range for their firm's debt ratios, but the capital structure decision is still more judgmental than based on precise calculations.

H.	How does the existence of asymmetric information and signaling affect capital structure?
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Answer: [Show S15-41 through S15-43 here.] The asymmetric information concept is based on the premise that management's choice of financing gives signals to investors. Firms with good investment opportunities will not want to share the benefits with new stockholders, so they will tend to finance with debt. Firms with poor prospects, on the other hand, will want to finance with stock. Investors know this, so when a large, mature firm announces a stock offering, investors take this as a signal of bad news, and the stock price declines. Firms know this, so they try to avoid having to sell new common stock. This means maintaining a reserve borrowing capacity so that when good investments come along, they can be financed with debt.

Optional Question

You might expect the price of a mature firm's stock to decline if it announces a stock offering. Would you expect the same reaction if the issuing firm were a young, rapidly growing company?

Answer: If a mature firm sells stock, the price of its stock would probably decline. A mature firm should have other financing alternatives, so a stock issue would signal that its earnings potential is not good. A young, rapidly growing firm, however, may have so many good investment opportunities that it simply cannot raise all the equity it needs as retained earnings, and investors know this. Therefore, the stock price of a young, rapidly growing firm would probably not fall because of a new stock issue, especially if the firm's managers announce that they are not selling any of their own shares in the offering.