16-1  a. Capital structure is the manner in which a firm’s assets are financed; that is, the right-hand side of the balance sheet. Capital structure is normally expressed as the percentage of each type of capital used by the firm—debt, preferred stock, and common equity.

b. Business risk is the risk inherent in the operations of the firm, prior to the financing decision. Thus, business risk is the uncertainty inherent in a total risk sense, future operating income, or earnings before interest and taxes (EBIT). Business risk is caused by many factors. Two of the most important are sales variability and operating leverage.

c. Financial risk is the risk added by the use of debt financing. Debt financing increases the variability of earnings before taxes (but after interest); thus, along with business risk, it contributes to the uncertainty of net income and earnings per share. Business risk plus financial risk equals total corporate risk.

d. Operating leverage is the extent to which fixed costs are used in a firm’s operations. If a high percentage of a firm’s total costs are fixed costs, then the firm is said to have a high degree of operating leverage. Operating leverage is a measure of one element of business risk, but does not include the second major element, sales variability.

e. Financial leverage is the extent to which fixed-income securities (debt and preferred stock) are used in a firm’s capital structure. If a high percentage of a firm’s capital structure is in the form of debt and preferred stock, then the firm is said to have a high degree of financial leverage.

f. The breakeven point is that level of unit sales at which costs equal revenues. Breakeven analysis may be performed with or without the inclusion of financial costs. If financial costs are not included, breakeven occurs when EBIT equals zero. If financial costs are included, breakeven occurs when EBT equals zero.

g. Capital structure theory provides some insights into the value of debt versus equity financing. Modern capital structure theory began in 1958, when Modigliani and Miller proved, under a very restrictive set of assumptions, that a firm’s value is unaffected by its capital structure. MM’s work marked the beginning of capital structure research, and subsequent research has focused on relaxing the MM assumptions in order to develop a more realistic theory of capital structure.
h. Perpetual cash flow analysis is a means for determining the value of securities which provide perpetual cash flows, such as preferred and common stock, to their owners. This analysis generally involves usage of discounted cash flow (DCF) valuation equations.

i. Reserve borrowing capacity exists when a firm uses less debt under “normal” conditions than called for by the tradeoff theory. This allows the firm some flexibility to use debt in the future when additional capital is needed.

16-2 Business risk refers to the uncertainty inherent in projections of future ROE.

16-3 Firms with relatively high nonfinancial fixed costs are said to have a high degree of operating leverage.

16-4 Operating leverage affects EBIT and, through EBIT, EPS. Financial leverage has no effect on EBIT--it only affects EPS, given EBIT.

16-5 If sales tend to fluctuate widely, then cash flows and the ability to service fixed charges will also vary. Such a firm is said to have high business risk. Consequently, there is a relatively large risk that the firm will be unable to meet its fixed charges, and interest payments are fixed charges. As a result, firms in unstable industries tend to use less debt than those whose sales are subject to only moderate fluctuations.

16-6 Public utilities place greater emphasis on long-term debt because they have more stable sales and profits as well as more fixed assets. Also, utilities have fixed assets which can be pledged as collateral. Further, trade firms use retained earnings to a greater extent, probably because these firms are generally smaller and, hence, have less access to capital markets. Public utilities have lower retained earnings because they have high dividend payout ratios and a set of stockholders who want dividends.

16-7 Any financial plan today involves predictions of the future economic outlook. If these predictions can be made with a high degree of confidence, the financial manager can use debt funds in his/her operations with greater assurance. The burdens of long-term debt can be assumed with greater confidence because sales, costs, and profits are less vulnerable to fluctuations. Therefore, the ability to meet fixed financial obligations is more assured. The firms that will benefit most from the increase in the reliability of economic forecasts are those most vulnerable to cyclical fluctuations in their own operations.

16-8 EBIT depends on sales and operating costs. Interest is deducted from EBIT. At high debt levels, firms lose business, employees worry, and operations are not continuous because of financing difficulties. Thus, financial leverage can influence sales and costs, and hence EBIT, if excessive leverage is used.

16-9 In the text, the firm was assumed to buy back its stock at the higher equilibrium price. If it could be bought at the lower price, a given
amount of debt would buy back more shares; hence, the remaining shares would have an even higher equilibrium value. It would not be fair for a company to buy back its stock without first announcing its intention to do so. Stockholders would be angry if they found out that they had sold out to a firm undergoing a value-raising recapitalization. Some stockholders would be angry enough to sue management, and they would win.

16-11 The tax benefits from debt increase linearly, which causes a continuous increase in the firm’s value and stock price. However, financial distress costs get higher and higher as more and more debt is employed, and these costs eventually offset and begin to outweigh the benefits of debt.
16-1  a. Here are the steps involved:

(1) Determine the variable cost per unit at present, V:

\[ \text{Profit} = P(Q) - FC - V(Q) \]
\[ $500,000 = ($100,000)(50) - $2,000,000 - V(50) \]
\[ 50(V) = $2,500,000 \]
\[ V = $50,000. \]

(2) Determine the new profit level if the change is made:

\[ \text{New profit} = P_2(Q_2) - FC_2 - V_2(Q_2) \]
\[ = $95,000(70) - $2,500,000 - ($50,000 - $10,000)(70) \]
\[ = $1,350,000. \]

(3) Determine the incremental profit:

\[ \text{Profit} = $1,350,000 - $500,000 = $850,000. \]

(4) Estimate the approximate rate of return on new investment:

\[ \text{ROI} = \text{Profit/Investment} = $850,000/$4,000,000 = 21.25%. \]

Since the ROI exceeds the 15 percent cost of capital, this analysis suggests that the firm should go ahead with the change.

b. If we measure operating leverage by the ratio of fixed costs to total costs at the expected output, then the change would increase operating leverage:

Old: \[ \frac{FC}{FC + V(Q)} = \frac{$2,000,000}{$2,000,000 + $2,500,000} = 44.44\%. \]

New: \[ \frac{FC_2}{FC_2 + V_2(Q_2)} = \frac{$2,500,000}{$2,500,000 + $2,800,000} = 47.17\%. \]

The change would also increase the breakeven point:

Old: \[ Q_{BE} = \frac{F}{P - V} = \frac{$2,000,000}{$100,000 - $50,000} = 40 \text{ units}. \]

New: \[ Q_{BE} = \frac{$2,500,000}{95,000 - $40,000} = 45.45 \text{ units}. \]

However, one could measure operating leverage in other ways, say by degree of operating leverage:
Old: \( \text{DOL} = \frac{Q(P - V)}{Q(P - V) - F} = \frac{50(50,000)}{50(50,000) - 2,000,000} = 5.0. \)

New: The new DOL, at the expected sales level of 70, is

\[ \frac{70(95,000 - 40,000)}{70(55,000) - 2,500,000} = 2.85. \]

The problem here is that we have changed both output and sales price, so the DOLs are not really comparable.

c. It is impossible to state unequivocally whether the new situation would have more or less business risk than the old one. We would need information on both the sales probability distribution and the uncertainty about variable input cost in order to make this determination. However, since a higher breakeven point, other things held constant, is more risky, the change in breakeven points—and also the higher percentage of fixed costs—suggests that the new situation is more risky.

16-2 a. Expected ROE for Firm C:

\[ \text{ROE}_C = (0.1)(-5.0\%) + (0.2)(5.0\%) + (0.4)(15.0\%) + (0.2)(25.0\%) + (0.1)(35.0\%) = 15.0\%. \]

Note: The distribution of \( \text{ROE}_C \) is symmetrical. Thus, the answer to this problem could have been obtained by simple inspection.

Standard deviation of ROE for Firm C:

\[ \sigma_C = \sqrt{0.1(-5.0 - 15.0)^2 + 0.2(25.0 - 15.0)^2 + 0.4(15.0 - 15.0)^2 + 0.2(25.0 - 15.0)^2 + 0.1(35.0 - 15.0)^2} \]

\[ = \sqrt{0.1(-20)^2 + 0.2(-10)^2 + 0.4(0)^2 + 0.2(10)^2 + 0.1(20)^2} = \sqrt{40 + 40 + 0 + 20 + 40} = \sqrt{120} = 11.0\%. \]

b. According to the standard deviations of ROE, Firm A is the least risky, while C is the most risky. However, this analysis does not take into account portfolio effects— if C’s ROE goes up when most other companies’ ROEs decline (that is, its beta is negative), its apparent riskiness would be reduced.

c. Firm A’s \( \sigma_{\text{ROE}} = \sigma_{\text{BEP}} = 5.5\% \). Therefore, Firm A uses no financial leverage and has no financial risk. Firm B and Firm C have \( \sigma_{\text{ROE}} > \sigma_{\text{BEP}} \), and hence both use leverage. Firm C uses the most leverage because it has the highest \( \sigma_{\text{ROE}} - \sigma_{\text{BEP}} \) = measure of financial risk. However, Firm C’s stockholders also have the highest expected ROE.

16-3 a. \( V = \text{Value of debt} + \text{Value of equity} = D + S = D + \frac{(\text{EBIT} - I)(1 - T)}{k_s}. \)
Calculation of EBIT:
Sales $12,000,000
Variable costs $6,000,000
Fixed costs 5,000,000
Total costs before interest and taxes 11,000,000
EBIT = $ 1,000,000

I = Interest cost of the original $1,000,000 debt at 8%
+ Interest cost of incremental $1,000,000 debt at 9%
= $1,000,000(0.08) + $1,000,000(0.09) = $80,000 + $90,000 = $170,000.

V = $2,000,000 + \frac{($1,000,000-170,000)(1-0.4)}{0.115}
= $2,000,000 + $4,330,435 = $6,330,435.

Since the value of the firm increases from its current value of $6,257,143 to $6,330,435 by increasing the debt from $1,000,000 to $2,000,000, the firm should increase its use of debt.

b. Value of the firm with debt = $3,000,000:

I = Interest cost of original $1,000,000 debt at 8%
+ Interest cost of incremental $2,000,000 at 12%
= $1,000,000(0.08) + $2,000,000(0.12) = $320,000.

V = $3,000,000 + \frac{($1,000,000-320,000)(1-0.4)}{0.15}
= $5,720,000.

Since increasing the debt from $2 million to $3 million would cause the value of the firm to decline, it should limit its use of debt to $2 million.

c. The original market price of the firm’s stock was $20. We can use this information to determine the number of shares outstanding:

\[
\text{Shares outstanding} = \frac{\text{Value of equity}}{\text{Price}} = \frac{S}{P} = \frac{V - D}{P}
\]
\[
n = \frac{6,257,143 - 1,000,000}{20} = 262,857 \text{ shares}.
\]

The firm increases its leverage by selling debt and repurchasing its shares of stock. The repurchase price is the equilibrium price that would prevail after the repurchase transaction. The original shareholders would sell their stock only at a price that incorporated the increased value of the firm resulting from the repurchase:

\[
P_1 = \frac{V - D}{n_0}
\]
At \( D = $2 \text{ million} \):  
\[ P_1 = \frac{($6,330,435 - $1,000,000)}{262,857} = $20.28. \]

At \( D = $3 \text{ million} \):  
\[ P_1 = \frac{($5,720,000 - $1,000,000)}{262,857} = $17.96. \]

d. Since the firm pays out all its earnings as dividends, \( \text{DPS} = \text{EPS} \).

\[ P = \frac{\text{DPS}}{k_s} = \frac{\text{EPS}}{k}, \text{ and } \text{EPS} = (P)(k). \]

\[ \text{EPS}(D = $1 \text{ million}) = ($20.00)(0.105) = $2.10. \]
\[ \text{EPS}(D = $2 \text{ million}) = ($20.28)(0.115) = $2.33. \]
\[ \text{EPS}(D = $3 \text{ million}) = ($17.96)(0.150) = $2.69. \]

Although the firm’s EPS is higher at \( D = $3 \text{ million} \), the firm should not increase its debt from \$2 to \$3 million because the stock price is higher at a debt level of \$2 million. The optimum capital structure is the one that maximizes stock price rather than EPS.

e. The value of the old bonds would decline. They have a fixed coupon rate, so \( k_d \) rises because of added financial risk, and the value of the bonds must fall. This value is transferred to the stockholders. For exactly this reason, bond indentures do place limits on the amount of additional debt firms can issue.

16-4 a. Original value of the firm (\( D = $0 \)):

\[ V = D + \frac{(\text{EBIT} - I)(1 - T)}{k_s} \]
\[ = 0 + \frac{($500,000 - $0)(1 - 0.4)}{0.10} = $0 + $3,000,000 = $3,000,000. \]

With financial leverage (\( D = $900,000 \)):

\[ V = D + \frac{(\text{EBIT} - I)(1 - T)}{k_s}. \]

\[ I = \text{Interest cost} = k_sD = (0.07)($900,000) = $63,000. \]

\[ V = $900,000 + \frac{($500,000 - $63,000)(1 - 0.4)}{0.11} \]
\[ = $900,000 + $2,383,636 = $3,283,636. \]

Increasing the financial leverage by adding \$900,000 of debt results in an increase in the firm’s value from \$3,000,000 to \$3,283,636.

b. Shares are repurchased at the equilibrium market price that prevails after the announcement of the transaction. This is because existing
shareholders would only sell at a price that incorporated the increased value of the firm resulting from the repurchase. We know that

\[ P_1 = \frac{V_1 - D_1}{n} \]

thus \( P_1 = \frac{$3,283,636}{200,000} = $16.42, \)

up from $15 with zero debt financing.

c. Since the firm pays out all earnings as dividends, \( DPS = EPS, \) and

\[ P = \frac{DPS}{k_s} = \frac{EPS}{k_s}. \]

Therefore, \( EPS = (P)(k_s). \)

Initial position: \( EPS = ($15.00)(0.10) = $1.50. \)

With financial leverage: \( EPS = ($16.42)(0.11) = $1.81. \)

Thus, by adding $900,000 of debt, the firm increased its EPS by $0.31.

Confirm this as follows:

\[ EPS = \frac{\text{Net income}}{\text{Shares outstanding}} = \frac{($500,000 - $63,000)(0.6)}{200,000 - ($900,000 / $16.42)} = \frac{$262,200}{145,189} = $1.81. \]

d. Zero debt: \( EPS = \frac{\text{EBIT}(1 - T)}{n} = \frac{\text{EBIT}(0.6)}{200,000}. \)

<table>
<thead>
<tr>
<th>Probability</th>
<th>EPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.10</td>
<td>($0.30)</td>
</tr>
<tr>
<td>0.20</td>
<td>0.60</td>
</tr>
<tr>
<td>0.40</td>
<td>1.50</td>
</tr>
<tr>
<td>0.20</td>
<td>2.40</td>
</tr>
<tr>
<td>0.10</td>
<td>3.30</td>
</tr>
</tbody>
</table>

$900,000 debt: \( EPS = \frac{\text{EBIT} - I)(1 - T)}{n} = \frac{(\text{EBIT} - $63,000)(0.6)}{145,189}. \)

<table>
<thead>
<tr>
<th>Probability</th>
<th>EPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.10</td>
<td>($0.67)</td>
</tr>
<tr>
<td>0.20</td>
<td>0.57</td>
</tr>
<tr>
<td>0.40</td>
<td>1.81</td>
</tr>
<tr>
<td>0.20</td>
<td>3.05</td>
</tr>
<tr>
<td>0.10</td>
<td>4.29</td>
</tr>
</tbody>
</table>

By inspection, the EPS distribution at $900,000 debt is more variable, and hence riskier in the total risk sense.
e. Zero debt: \[ \text{TIE} = \frac{\text{EBIT}}{\text{I}} = \frac{\text{EBIT}}{0} = \text{Undefined.} \]

$900,000$ debt: \[ \text{TIE} = \frac{\text{EBIT}}{\text{I}} = \frac{\text{EBIT}}{63,000}. \]

<table>
<thead>
<tr>
<th>Probability</th>
<th>EPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.10</td>
<td>1.59</td>
</tr>
<tr>
<td>0.20</td>
<td>3.17</td>
</tr>
<tr>
<td>0.40</td>
<td>7.94</td>
</tr>
<tr>
<td>0.20</td>
<td>12.70</td>
</tr>
<tr>
<td>0.10</td>
<td>17.46</td>
</tr>
</tbody>
</table>

The interest payment is not covered when TIE < 1.0. The probability of this occurring is 0.10, or 10 percent.

16-5 a. Present situation (in millions):

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBIT</td>
<td>$13.24</td>
</tr>
<tr>
<td>Interest</td>
<td>5.00</td>
</tr>
<tr>
<td>EBT</td>
<td>$8.24</td>
</tr>
<tr>
<td>Taxes (15%)</td>
<td>1.24</td>
</tr>
<tr>
<td>Net income</td>
<td>$7.00</td>
</tr>
</tbody>
</table>

\[ \text{DPS} = \frac{\text{EPS}}{\text{Shares}} = \frac{7 \text{ million}}{1 \text{ million}} = 7.00. \]

\[ k_s = \frac{\text{DPS}}{\text{P}_s} = \frac{7.00}{50} = 14.0\% \text{ at present.} \]

b. Original leverage (D = $50 million):

\[ V = D + \frac{(\text{EBIT} - D(k_s))(1 - T)}{k_s} \]
\[ = 50 + \frac{(13.24 - 5)(1 - 0.15)}{0.14} = 50 + 50 = 100 \text{ million.} \]

Decrease leverage (D = $30 million):

\[ V = 30 + \frac{(13.24 - 2.4)(0.85)}{0.13} = 30 + 70.88 = 100.88 \text{ million.} \]

Increase leverage (D = $70 million):

\[ V = 70 + \frac{(13.24 - 8.4)(0.85)}{0.16} = 70 + 25.71 = 95.71 \text{ million.} \]
Since the value of the company increases with a decrease in leverage to $30 million, the company should decrease its capital structure from $50 million debt to $30 million debt. This can be verified by looking at what the new stock price would be if $30 million debt were used in the capital structure:

\[ P_1 = \frac{\text{New value of company} - \text{Old value of debt}}{\text{Old shares outstanding}}. \]

For \( D = \$30 \text{ million} \):

\[ P_1 = \frac{100,880,000 - 50,000,000}{1,000,000} = 50.88 \text{ versus } 50.00 = P_0. \]

c. \( V = 50 + \frac{(13.24 - 5)(0.66)}{0.14} = 50 + 38.85 = 88.85 \text{ million}. \)

The stock price falls to \( (88.85 \text{ million} - 50 \text{ million})/\text{(1 million shares)} = 38.85 \).

d. If the firm uses \( \$30 \text{ million} \) of 8 percent debt, the value will be:

\[ V = 30 + \frac{(13.24 - 2.4)(0.66)}{0.13} = 85.03 \text{ million}. \]

\[ P_1 = \frac{85,030,000 - 50,000,000}{1,000,000} = 35.03. \]

If the firm uses \( \$70 \text{ million} \) of 12 percent debt, the value will be:

\[ V = 70 + \frac{(13.24 - 8.4)(0.66)}{0.13} = 89.97 \text{ million}. \]

\[ P_1 = \frac{V - D_i}{n_s} = \frac{89,970,000 - 50,000,000}{1,000,000} = 39.97. \]

Thus, with the higher tax rates, the value of the firm is maximized with more financial leverage. The final stock price, if more leverage is used, will be 39.97, up from 38.85 with only $50 million of debt. (The equilibrium value, after refinancing, of the firm will be $89.97 million. Investors would recognize that this value will exist shortly, so the current stock price would reflect this value. The current value of the debt is $50 million, so the current value of equity is $89.97 - $50 = $39.97 million. Since there are 1 million shares now outstanding, each share will sell for $39.97.)

This problem illustrates a very important principle: The major advantage of debt financing is the fact that interest is a tax-deductible expense. The value of a tax deduction depends on the tax.
rate. Thus, when the tax rate is high, like 34 percent, leverage has a more favorable impact than when it is low (15%). Companies in high tax brackets get more benefits from the use of financial leverage. $k_d(1 - T)$ is smaller if $T$ is larger.

e. If the firm’s 10 percent debt could not be called, then it would be difficult to reduce leverage. The bonds might be bought on the open market, but if the company lowered its leverage, $k_d$ would decline, causing the 10 percent bonds’ prices to rise. This would mean that the firm would have to pay a premium to retire its old bonds, and this would reduce the benefits of the refunding.

If the firm increased its leverage to $70 million, its old debt would decline in value as $k_d$ rose, because of the added risk of additional debt. Thus, the value of the firm would be:

$$V = D_1 + D_2 + S,$$

where $D_1$ is the (below par) value of the old bonds and $D_2$ is the (par) value of the new bonds.

The value of the stock, $S$, would be higher than in the case where the old bonds must be refunded because the interest payments are now lower as a result of continuing to use 10 percent debt even after $k_d$ rises to 12 percent. At $T = 15\%$, and $D = $70 million:

$$S = \frac{[EBIT - (Old k_d)(Old debt) - (New k_d)(New debt)](1 - T)}{k_d}$$
$$= \frac{[13.24 - 5 - 0.12(20)](0.85)}{0.16} = $31.03 million,$$

up from $25.7 million in Part b of the solution. This assumes the old debt is a perpetuity and remains outstanding forever. If this were not the case, and the old debt had to eventually be retired, then the value of the equity would eventually fall to $25.7 million.

Note that the value of the old bonds would decline from $50 million to:

$$V_o = \frac{k_d(50M)}{0.12} = \frac{5M}{0.12} = $41,666,667 = $41.67 million,$$

or by $8,333,333. The value of the equity would rise by $31,030,000 - $25,700,000 = $5,330,000.

The new total value of the firm would be:

$$V_1 = Value \ of \ old \ debt + Value \ of \ new \ debt + Value \ of \ stock$$
$$= 41.67 + 20.00 + 31.03 = $92.7 million.$$

Thus, the value of the firm would fall by $7.3 million as a result of the increased leverage, but the value of the equity would rise by...
$5.33$ million. Obviously, stockholders would be benefiting at the expense of the old bondholders.

The price of the stock would be $51.03:

$$P_1 = \frac{V - D_{old}}{n_{old}} = \frac{92,700,000 - 41,670,000}{1,000,000} = 51.03.$$  

This is up from $50.

f. Under these assumptions, here are the income statements:

<table>
<thead>
<tr>
<th>Probability</th>
<th>0.2</th>
<th>0.6</th>
<th>0.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBIT</td>
<td>$5,000,000</td>
<td>$15,000,000</td>
<td>$25,000,000</td>
</tr>
</tbody>
</table>

Debt = $70 million:

Interest:

<table>
<thead>
<tr>
<th></th>
<th>Old</th>
<th>New</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBT</td>
<td>($2,400,000)</td>
<td>$7,600,000</td>
</tr>
<tr>
<td>Taxes (at 15%)</td>
<td>(360,000)</td>
<td>1,140,000</td>
</tr>
<tr>
<td>Net income</td>
<td>($2,040,000)</td>
<td>$6,460,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EPS*</th>
<th>($3.35)</th>
<th>$10.62</th>
<th>$24.60</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected EPS</td>
<td>$10.62</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\sigma_{EPS}$**</td>
<td>$8.84$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CV$_{EPS}$</td>
<td>0.83</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TIE = EBIT/I</td>
<td>0.68x</td>
<td>2.03x</td>
<td>3.38x</td>
</tr>
<tr>
<td>E(TIE)</td>
<td>2.03x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\sigma_{TIE}$</td>
<td>0.85x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CV$_{TIE}$</td>
<td>0.42</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*$n_1 = 1,000,000 - ($20,000,000/$51.03) = 608,074.$

**$\sigma_{EPS} = \sqrt{(x_1 - \bar{x})^2 P_1}.$
Here is a list of some of the factors which influence the capital structure decision and how they apply to Firms A and Z. Each factor is analyzed assuming that the other factors are irrelevant.

Business risk. A’s business risk is probably higher than Z’s since it faces far more uncertainty in sales demand and margins, and hence revenues. Thus, Z should be able to use higher leverage before it faces significant financial distress costs.

Reserve borrowing capacity. Firm A would probably have a greater requirement for reserve borrowing capacity. It is in a highly volatile, fast-growth business and is more likely to face uncertain equity markets. Thus, Firm A should favor lower leverage.

Asset structure. Firm Z has a higher percentage of assets suitable as collateral. Thus, Firm Z can probably carry more debt.

Ownership structure. Firm Z’s majority stockholders (the founder’s family) may have much of their personal wealth tied up in the company. If this is the case, their lack of diversification may indicate less leverage, and hence less risk of financial distress, for Firm Z.

Profitability. Firm A is more profitable. Thus, it can retain more funds and this lessens the debt requirement. Conversely, highly profitable firms can carry more debt.

Taxes. Firm Z’s accelerated depreciation expenses tend to lower its effective tax rate, which decreases the benefits of debt financing.

Here is a matrix summarizing the analysis. A plus (+) indicates that the factor favors higher leverage, while a minus (−) indicates lower leverage. A zero (0) indicates uncertain effects.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Firm A</th>
<th>Firm Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business risk</td>
<td>−</td>
<td>+</td>
</tr>
<tr>
<td>Reserve borrowing capacity</td>
<td>−</td>
<td>0</td>
</tr>
<tr>
<td>Asset structure</td>
<td>−</td>
<td>+</td>
</tr>
<tr>
<td>Ownership structure</td>
<td>0</td>
<td>−</td>
</tr>
<tr>
<td>Profitability</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Taxes</td>
<td>+</td>
<td>−</td>
</tr>
</tbody>
</table>

All in all, it is tough to balance out the contradictory effects. However, working managers have a better feel for which factors are most relevant to their firms.

16-7  

a. BEA’s current cost of equity is $k_e = \text{dividends}/\text{price} = (8,333,000 - 20,000,000 \times 0.08) \times (1 - 0.40) / 40,000,000 = 10.10\%

BEA’s current beta comes from 10.10 = 6 + b(4) so b = 4.10/4 = 1.025.

b. BEA’s unlevered beta is $b_u = b_e / (1 + (1-T)(D/E)) = 1.025 / (1 + (1-0.40)(20/40)) = 0.788. BEA’s unlevered cost of equity is 6 + 0.788(4) = 9.153\%
c. \( b_3 = b_4 (1 + (1-T)(D/E)) \). Note that the book value of equity is $40 million.

At $30 million: \( b_{30} = 0.788 \times (1 + 0.6(30/40)) = 1.143 \). \( k_s = 6 + 1.143 \times (4) = 10.57\% \)

At $40 million: \( b_{40} = 0.788(1+0.6(40/40)) = 1.261 \). \( k_s = 6 + 1.261 \times (4) = 11.05\% \)

At $50 million: \( b_{50} = 0.788(1+0.6(50/40)) = 1.379 \). \( k_s = 6 + 1.379 \times (4) = 11.52\% \)

d. Total Value = MV Equity + Debt. MV Equity = Dividend\(k_s\) for a zero growth firm that pays out all of its earnings, like BEA does, and Dividends = (EBIT - Debt \(k_d\)) (1-T).

At $20 million: MV Equity = 40,000,000. Debt = 20,000,000. Total Value = $60.0 million.

At $30 million: MV Equity = (8,333,000 - 30,000,000 (8.5%))(0.60)/0.1057 = $32.8 million. Total Value of the firm is $32.8 million + $30 million = $62.8 million.

At $40 million: MV Equity = (8,333,000 - 40,000,000 (9.5%))(0.60)/0.1105 = $26.6 million. Total Value of the firm is 24.6 million + 40 million = $64.6 million.

At $50 million: MV Equity = (8,333,000 - 50,000,000 (11.2%))(0.60)/0.1152 = $14.2 million. Total Value of the firm is $14.2 million + 50 million = $64.2 million.

So the maximum total value of the firm occurs at $40,000,000 in debt.

---

16-8 Tax rate = 40\% \( k_{RF} = 5.0\% \)  
\( b_0 = 1.2 \) \( k_M - k_{RF} = 6.0\% \)

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

<table>
<thead>
<tr>
<th>D/A</th>
<th>E/A</th>
<th>D/E</th>
<th>( k_s )</th>
<th>( k_s(1 - T) )</th>
<th>Leveraged beta(^a)</th>
<th>( k_s^b )</th>
<th>WACC(^c)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>1.00</td>
<td>0.0000</td>
<td>7.00%</td>
<td>4.20%</td>
<td>1.20</td>
<td>12.20%</td>
<td>12.20%</td>
</tr>
<tr>
<td>0.20</td>
<td>0.80</td>
<td>0.2500</td>
<td>8.00</td>
<td>4.80</td>
<td>1.38</td>
<td>13.28</td>
<td>11.58</td>
</tr>
<tr>
<td>0.40</td>
<td>0.60</td>
<td>0.6667</td>
<td>10.00</td>
<td>6.00</td>
<td>1.68</td>
<td>15.08</td>
<td>11.45</td>
</tr>
<tr>
<td>0.60</td>
<td>0.40</td>
<td>1.5000</td>
<td>12.00</td>
<td>7.20</td>
<td>2.28</td>
<td>18.68</td>
<td>11.79</td>
</tr>
<tr>
<td>0.80</td>
<td>0.20</td>
<td>4.0000</td>
<td>15.00</td>
<td>9.00</td>
<td>4.08</td>
<td>29.48</td>
<td>13.10</td>
</tr>
</tbody>
</table>

Notes:
These beta estimates were calculated using the Hamada equation, $b = b_u [1 + (1 - T)(D/E)]$.

These $k_s$ estimates were calculated using the CAPM, $k_s = k_{RF} + (k_M - k_{RF})b$.

These WACC estimates were calculated with the following equation: 
$$WACC = w_d (k_d) (1 - T) + (w_e) (k_s).$$

The firm’s optimal capital structure is that capital structure which minimizes the firm’s WACC. Elliott’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%.