After studying Chapter 16, you should be able to:

- Define operating and financial leverage and identify causes of both.
- Calculate a firm's operating break-even (quantity) point and break-even (sales) point.
- Define, calculate, and interpret a firm's degree of operating, financial, and total leverage.
- Understand EBIT-EPS break-even, or indifference, analysis, and construct and interpret an EBIT-EPS chart.
- Define, discuss, and quantify "total firm risk" and its two components, "business risk" and "financial risk."
- Understand what is involved in determining the appropriate amount of financial leverage for a firm.
When a lever is used properly, a force applied at one point is transformed, or magnified, into another, larger force or motion at some other point. This comes most readily to mind when considering *mechanical leverage*, such as that which occurs when using a crowbar. In a business context, however, *leverage* refers to the use of fixed costs in an attempt to increase (or *lever up*) profitability. In this chapter we explore the principles of both *operating leverage* and *financial leverage*. The former is due to fixed operating costs associated with the production of goods or services, whereas the latter is due to the existence of fixed financing costs – in particular, interest on debt. Both types of leverage affect the level and variability of the firm’s after-tax earnings, and hence the firm’s overall risk and return.

**Operating Leverage**

Operating leverage is present any time a firm has fixed operating costs – regardless of volume. In the long run, of course, all costs are variable. Consequently, our analysis necessarily involves the short run. We incur fixed operating costs in the hope that sales volume will produce revenues more than sufficient to cover all fixed and variable operating costs. One of the more dramatic examples of an effect of operating leverage is the airline industry, where a large proportion of total operating costs is fixed. Beyond a certain break-even load factor, each additional passenger essentially represents straight operating profit (earnings before interest and taxes, or EBIT) to the airline.

It is essential to note that fixed operating costs do not vary as volume changes. These costs include such things as depreciation of buildings and equipment, insurance, part of the overall utility bills, and part of the cost of management. On the other hand, variable operating costs vary directly with the level of output. These costs include raw materials, direct labor costs, part of the overall utility bills, direct selling commissions, and certain parts of general and administrative expenses.

One interesting potential effect caused by the presence of fixed operating costs (operating leverage) is that a change in the volume of sales results in a *more than proportional* change in operating profit (or loss). Thus, like a lever used to magnify a force applied at one point into a larger force at some other point, the presence of fixed operating costs causes a percentage change in sales volume to produce a magnified percentage change in operating profit (or loss). (A note of caution: remember, leverage is a two-edged sword – just as a company’s profits can be magnified, so too can the company’s losses.)

This magnification effect is illustrated in Table 16.1. In Frame A we find three different firms possessing various amounts of operating leverage. Firm F has a heavy amount of fixed operating costs (FC) relative to variable costs (VC). Firm V has a greater dollar amount of variable operating costs than of fixed operating costs. Finally, Firm 2F has twice the amount of fixed operating costs as does Firm F. Notice that, of the three firms shown, Firm 2F has (1) the largest absolute dollar amount of fixed costs and (2) the largest relative amount of fixed costs as measured by both the (FC/total costs) and (FC/sales) ratios.

Each firm is then subjected to an anticipated 50 percent increase in sales for next year. Which firm do you think will be more sensitive to the change in sales: that is, for a given percentage change in sales, which firm will show the largest percentage change in operating profit (EBIT)? (Most people would pick Firm 2F – because it has either the largest absolute or the largest relative amount of fixed costs. Most people would be wrong.)
The results are shown in Frame B of Table 16.1. For each firm, sales and variable costs increase by 50 percent. Fixed costs do not change. All firms show the effects of operating leverage (that is, changes in sales result in more than proportional changes in operating profits). But Firm F proves to be the most sensitive firm, with a 50 percent increase in sales leading to a 400 percent increase in operating profit. As we have just seen, it would be an error to assume that the firm with the largest absolute or relative amount of fixed costs automatically shows the most dramatic effects of operating leverage. Later, we will come up with an easy way to determine which firm is most sensitive to the presence of operating leverage. But, before we can do so, we need to learn how to study operating leverage by means of break-even analysis.

### Table 16.1
Effect of operating leverage showing that changes in sales result in more than proportional changes in operating profit (EBIT)

<table>
<thead>
<tr>
<th>Frame A: Three firms before changes in sales</th>
<th>Firm F</th>
<th>Firm V</th>
<th>Firm 2F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>$10,000</td>
<td>$11,000</td>
<td>$19,500</td>
</tr>
<tr>
<td>Operating costs</td>
<td>7,000</td>
<td>2,000</td>
<td>14,000</td>
</tr>
<tr>
<td>Fixed (FC)</td>
<td>2,000</td>
<td>7,000</td>
<td>3,000</td>
</tr>
<tr>
<td>Variable (VC)</td>
<td>5,000</td>
<td>9,000</td>
<td>11,500</td>
</tr>
<tr>
<td>Operating profit (EBIT)</td>
<td>$ 1,000</td>
<td>$ 2,000</td>
<td>$ 2,500</td>
</tr>
<tr>
<td>Operating leverage ratios</td>
<td>0.78</td>
<td>0.22</td>
<td>0.82</td>
</tr>
<tr>
<td>FC/sales</td>
<td>0.70</td>
<td>0.18</td>
<td>0.72</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Frame B: Three firms after 50 percent increases in sales in following year</th>
<th>Firm F</th>
<th>Firm V</th>
<th>Firm 2F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>$15,000</td>
<td>$16,500</td>
<td>$29,250</td>
</tr>
<tr>
<td>Operating costs: Fixed (FC)</td>
<td>7,000</td>
<td>2,000</td>
<td>14,000</td>
</tr>
<tr>
<td>Variable (VC)</td>
<td>3,000</td>
<td>10,500</td>
<td>4,500</td>
</tr>
<tr>
<td>Operating profit (EBIT)</td>
<td>$ 5,000</td>
<td>$ 4,000</td>
<td>$10,750</td>
</tr>
<tr>
<td>Percent change in EBIT $(\frac{EBIT_t - EBIT_{t-1}}{EBIT_{t-1}})$</td>
<td>400%</td>
<td>100%</td>
<td>330%</td>
</tr>
</tbody>
</table>

The results are shown in Frame B of Table 16.1. For each firm, sales and variable costs increase by 50 percent. Fixed costs do not change. All firms show the effects of operating leverage (that is, changes in sales result in more than proportional changes in operating profits). But Firm F proves to be the most sensitive firm, with a 50 percent increase in sales leading to a 400 percent increase in operating profit. As we have just seen, it would be an error to assume that the firm with the largest absolute or relative amount of fixed costs automatically shows the most dramatic effects of operating leverage. Later, we will come up with an easy way to determine which firm is most sensitive to the presence of operating leverage. But, before we can do so, we need to learn how to study operating leverage by means of break-even analysis.

### Break-Even Analysis

To illustrate break-even analysis as applied to the study of operating leverage, consider a firm that produces a high-quality child’s bicycle helmet that sells for $50 a unit. The company has annual fixed operating costs of $100,000, and variable operating costs are $25 a unit regardless of the volume sold. We wish to study the relationship between total operating costs and total revenues. One means for doing so is with the break-even chart in Figure 16.1, which shows the relationship among total revenues, total operating costs, and profits for various levels of production and sales. As we are concerned only with operating costs at this point, we define profits here to mean operating profits before taxes. This definition purposely excludes interest on debt and preferred stock dividends. These costs are not part of the total fixed operating costs of the firm and have no relevance when it comes to analyzing operating leverage. They are taken into account, however, when we analyze financial leverage in the next section.

**Break-Even (Quantity) Point.** The intersection of the total costs line with the total revenues line determines the break-even point. The break-even point is the sales volume required for total revenues to equal total operating costs or for operating profit to equal zero. In Figure 16.1 this break-even point is 4,000 units of output (or $200,000 in sales). Mathematically, we find this point (in units) by first noting that operating profit (EBIT) equals total revenues minus variable and fixed operating costs:

\[ \text{EBIT} = \text{TR} - (\text{VC} + \text{FC}) \]
EBIT = P(Q) - V(Q) - FC = Q(P - V) - FC \hspace{1cm} [16.1]

where EBIT = earnings before interest and taxes (operating profit) 
\( P \) = price per unit 
\( V \) = variable costs per unit 
\( P - V \) = unit contribution margin 
\( Q \) = quantity (units) produced and sold 
\( FC \) = fixed costs

At the break-even point \((Q_{BE})\), EBIT is zero. Therefore,

\[ 0 = Q_{BE}(P - V) - FC \hspace{1cm} [16.2] \]

Rearranging Eq. (16.2), the break-even point is

\[ Q_{BE} = FC/(P - V) \hspace{1cm} [16.3] \]

Thus the break-even (quantity) point is equal to fixed costs divided by the unit contribution margin \((P - V)\). In our example,

\[ Q_{BE} = \$100,000/($50 - $25) = 4,000 \text{ units} \]

For additional increments of volume above the break-even point, there are increases in profits, which are represented by the darker area in Figure 16.1. Likewise, as volume falls below the break-even point, losses increase, which are represented by the lighter area.

**Break-Even (Sales) Point.** Calculating a break-even point on the basis of dollar sales instead of units is often useful. Sometimes, as in the case of a firm that sells multiple products,
it is a necessity. It would be impossible, for example, to come up with a meaningful break-even point in total units for a firm such as General Electric, but a break-even point based on sales revenues could easily be imagined. When determining a general break-even point for a multiproduct firm, we assume that sales of each product are a constant proportion of the firm’s total sales.

Recognizing that at the break-even (sales) point the firm is just able to cover its fixed and variable operating costs, we turn to the following formula:

\[ S_{\text{BE}} = FC + VC_{\text{BE}} \]  \hspace{1cm} (16.4)

where \( S_{\text{BE}} \) = break-even sales revenues  
\( FC \) = fixed costs  
\( VC_{\text{BE}} \) = total variable costs at the break-even point

Unfortunately, we are now faced with a single equation containing two unknowns – \( S_{\text{BE}} \) and \( VC_{\text{BE}} \). Such an equation is insolvable. Luckily, there is a trick that we can use in order to turn Eq. (16.4) into a single equation with a single unknown. First, we need to rewrite Eq. (16.4) as follows:

\[ S_{\text{BE}} = FC + (VC_{\text{BE}}/S_{\text{BE}})S_{\text{BE}} \]  \hspace{1cm} (16.5)

Because the relationship between total variable costs and sales is assumed constant in linear break-even analysis, we can replace the ratio \( (VC_{\text{BE}}/S_{\text{BE}}) \) with the ratio of total variable costs to sales \( (VC/S) \) for any level of sales. For example, we can use the total variable costs and sales figures from the firm’s most recent income statement to produce a suitable \( (VC/S) \) ratio. In short, after replacing the ratio \( (VC_{\text{BE}}/S_{\text{BE}}) \) with the “generic” ratio \( (VC/S) \) in Eq. (16.5), we get

\[ S_{\text{BE}} = FC + (VC/S)S_{\text{BE}} \]  
\[ S_{\text{BE}}[1 - (VC/S)] = FC \]  
\[ S_{\text{BE}} = FC/[1 - (VC/S)] \] \hspace{1cm} (16.6)

For our example bicycle-helmet manufacturing firm, the ratio of total variable costs to sales is 0.50 regardless of sales volume. Therefore, using Eq. (16.6) to solve for the break-even (sales) point, we get

\[ S_{\text{BE}} = \$100,000/[1 - 0.50] = \$200,000 \]

At $50 a unit, this $200,000 break-even (sales) point is consistent with the 4,000 unit break-even (quantity) point determined earlier [i.e., (4,000)($50) = $200,000].

\[ \text{TIP•TIP} \]

You can easily modify break-even (quantity) Eq. (16.3) and break-even (sales) point Eq. (16.6) to calculate the sales volume (in units or dollars) required to produce a “target” operating income (EBIT) figure. Simply add your target or minimum desired operating income figure to fixed costs \( (FC) \) in each equation. The resulting answers will be your target sales volume – in units and dollars, respectively – needed to produce your target operating income figure.

Degree of Operating Leverage (DOL)

Earlier, we said that one potential effect of operating leverage is that a change in the volume of sales results in a more than proportional change in operating profit (or loss). A quantitative measure of this sensitivity of a firm’s operating profit to a change in the firm’s sales is called the degree of operating leverage (DOL). The degree of operating leverage of a firm at a particular level of output (or sales) is simply the percentage change in operating profit over the percentage change in output (or sales) that causes the change in profits. Thus,
The sensitivity of the firm to a change in sales as measured by DOL will be different at each level of output (or sales). Therefore, we always need to indicate the level of output (or sales) at which DOL is measured – as in \( DOL \) at \( Q \) units.

**TIP • TIP**

When you use Eq. (16.7) to describe DOL at the firm’s current level of sales, remember that you are dealing with future percentage changes in EBIT and sales as opposed to past percentage changes. Using last period’s percentage changes in the equation would give us what the firm’s DOL used to be as opposed to what it is currently.

It is often difficult to work directly with Eq. (16.7) to solve for the DOL at a particular level of sales because an anticipated percentage change in EBIT (the numerator in the equation) will not be observable from historical data. Thus, although Eq. (16.7) is crucial for defining and understanding DOL, a few simple alternative formulas derived from Eq. (16.7) are more useful for actually computing DOL values:

\[
DOL_{Q \text{ units}} = \frac{Q(P - V)}{Q(P - V) - FC} = \frac{Q}{Q - Q_{\text{BE}}} \quad \text{[16.8]}
\]

\[
DOL_{S \text{ dollars of sales}} = \frac{S - VC}{S - VC - FC} = \frac{EBIT + FC}{EBIT} \quad \text{[16.9]}
\]

Equation (16.8) is especially well suited for calculating the degree of operating leverage for a single product or a single-product firm. It requires only two pieces of information, \( Q \) and \( Q_{\text{BE}} \), both of which are stated in terms of units. Equation (16.9), on the other hand, comes in very handy for finding the degree of operating leverage for a multiproduct firm. It too requires only two pieces of information, \( EBIT \) and \( FC \), both of which are stated in dollar terms.

Suppose that we wish to determine the degree of operating leverage at 5,000 units of output and sales for our hypothetical example firm. Making use of Eq. (16.8), we have

\[
DOL_{5,000 \text{ units}} = \frac{5,000}{(5,000 - 4,000)} = 5
\]

For 6,000 units of output and sales, we have

\[
DOL_{6,000 \text{ units}} = \frac{6,000}{(6,000 - 4,000)} = 3
\]

**Take Note**

Notice that when output was increased from 5,000 to 6,000 units, the degree of operating leverage decreased from a value of 5 to a value of 3. Thus, the further the level of output is from the break-even point, the lower the degree of operating leverage. How close a firm operates to its break-even point – not its absolute or relative amount of fixed operating costs – determines how sensitive its operating profits will be to a change in output or sales.

---

1Self-correction Problem 4 at the end of this chapter asks you to mathematically derive Eq. (16.8) from Eq. (16.7).
What does “DOL$_{5,000}$ units = 5” really mean?

It means that a 1 percent change in sales from the 5,000-unit sales position causes a 5 percent change in EBIT. In fact, any percentage change in sales from the 5,000-unit position causes a percentage change in EBIT that is five times as large. For example, a 3 percent decrease in sales causes a 15 percent decrease in EBIT, and a 4 percent increase in sales causes a 20 percent increase in EBIT.

DOL and the Break-Even Point

Table 16.2 shows us the operating profit and degree of operating leverage for various levels of output (sales). We see that the further we move from the firm’s break-even point, the greater is the absolute value of the firm’s operating profit or loss and the lower is the relative sensitivity of operating profit to changes in output (sales) as measured by DOL. The linear relationship between operating profits and output (sales) has previously been revealed with the break-even chart in Figure 16.1. In Figure 16.2 we plot the distinctly nonlinear relationship between DOL and output (sales).

Given the stable, linear cost and revenue functions of our example firm, we see that DOL approaches positive (or negative) infinity as sales approach the break-even point from above (or below) that point. DOL approaches 1 as sales grow beyond the break-even point. This implies that the magnification effect on operating profits caused by the presence of fixed costs diminishes toward a simple 1-to-1 relationship as sales continue to grow beyond the break-even point. Figure 16.2 demonstrates that even firms with large fixed costs will have a low DOL if they operate well above their break-even point. By the same token, a firm with very low fixed costs will have an enormous DOL if it operates close to its break-even point.$^2$

$^2$The graph in Figure 16.2 is a rectangular hyperbola with asymptotes $Q = Q_{BE}$ and $DOL = 1$. All firms having stable, linear cost structures will have similar-looking graphs – but each firm’s graph will be centered above its own respective break-even point. Plotting DOL versus dollar sales instead of unit sales would produce a similar-looking result. Interestingly, one can produce a standardized graph that could serve for all firms if we plot $DOL$ versus $Q/Q_{BE}$ or $S/S_{BE}$ – that is, $DOL$ versus relative proximity to the break-even point. (The authors thank Professor James Gahlon for sharing this insight as well as other helpful leverage observations.) The interpretation here would be that a firm’s relative proximity to its break-even point determines its DOL. Further, all firms operating at the same relative distance from their break-even points (1.5 times $Q_{BE}$ or $S_{BE}$, for example) will have the same DOL.
How would knowledge of a firm’s DOL be of use to a financial manager?

The manager would know in advance what impact a potential change in sales would have on operating profit. Sometimes, in response to this advance knowledge, the firm may decide to make some changes in its sales policy and/or cost structure. As a general rule, firms do not like to operate under conditions of a high degree of operating leverage because, in that situation, a small drop in sales may lead to an operating loss.

DOL and Business Risk

It is important to recognize that the degree of operating leverage is only one component of the overall business risk of the firm. The other principal factors giving rise to business risk are variability or uncertainty of sales and production costs. The firm’s degree of operating leverage magnifies the impact of these other factors on the variability of operating profits. However, the degree of operating leverage itself is not the source of the variability. A high DOL means nothing if the firm maintains constant sales and a constant cost structure. Likewise, it would be a mistake to treat the degree of operating leverage of the firm as a synonym for its business risk. Because of the underlying variability of sales and production costs, however, the degree of operating leverage will magnify the variability of operating profits, and hence the company’s business risk. The degree of operating leverage should thus
be viewed as a measure of “potential risk” which becomes “active” only in the presence of sales and production cost variability.

**Question**

Now that you have a better understanding of DOL, how can you tell from only the information in Frame A of Table 16.1 which firm – F, V, or 2F – will be more sensitive to the anticipated 50 percent increase in sales for the next year?

**Answer**

Simple. Calculate the DOL – using \([(EBIT + FC)/EBIT]\) – for each firm, and then pick the firm with the largest DOL.

Firm F: \(DOL_{\$10,000 \text{ of sales}} = \frac{\$1,000 + \$7,000}{\$1,000} = 8\)

Firm V: \(DOL_{\$11,000 \text{ of sales}} = \frac{\$2,000 + \$2,000}{\$2,000} = 2\)

Firm 2F: \(DOL_{\$19,500 \text{ of sales}} = \frac{\$2,500 + \$14,000}{\$2,500} = 6.6\)

In short, Firm F – with a DOL of 8 – is most sensitive to the presence of operating leverage. That is why a 50 percent increase in sales in the following year causes a 400 percent (8 \(\times\) 50%) increase in operating profit.

**Financial Leverage**

Financial leverage involves the use of fixed cost financing. Interestingly, financial leverage is acquired by choice, but operating leverage sometimes is not. The amount of operating leverage (the amount of fixed operating costs) employed by a firm is sometimes dictated by the physical requirements of the firm’s operations. For example, a steel mill by way of its heavy investment in plant and equipment will have a large fixed operating cost component consisting of depreciation. Financial leverage, on the other hand, is always a choice item. No firm is required to have any long-term debt or preferred stock financing. Firms can, instead, finance operations and capital expenditures from internal sources and the issuance of common stock. Nevertheless, it is a rare firm that has no financial leverage. Why, then, do we see such reliance on financial leverage?

Financial leverage is employed in the hope of increasing the return to common shareholders. Favorable or positive leverage is said to occur when the firm uses funds obtained at a fixed cost (funds obtained by issuing debt with a fixed interest rate or preferred stock with a constant dividend rate) to earn more than the fixed financing costs paid. Any profits left after meeting fixed financing costs then belong to common shareholders. Unfavorable or negative leverage occurs when the firm does not earn as much as the fixed financing costs. The favorability of financial leverage, or “trading on the equity” as it is sometimes called, is judged in terms of the effect that it has on earnings per share to the common shareholders. In effect, financial leverage is the second step in a two-step profit-magnification process. In step one, operating leverage magnifies the effect of changes in sales on changes in operating profit. In step two, the financial manager has the option of using financial leverage to further magnify the effect of any resulting changes in operating profit on changes in earnings per share. In the next section we are interested in determining the relationship between earnings per share (EPS) and operating profit (EBIT) under various financing alternatives and the **indifference points** between these alternatives.
EBIT-EPS Break-Even, or Indifference, Analysis

Calculation of Earnings per Share. To illustrate an EBIT-EPS break-even analysis of financial leverage, suppose that Cherokee Tire Company with long-term financing of $10 million, consisting entirely of common stock equity, wishes to raise another $5 million for expansion through one of three possible financing plans. The company may gain additional financing with a new issue of (1) all common stock, (2) all debt at 12 percent interest, or (3) all preferred stock with an 11 percent dividend. Present annual earnings before interest and taxes (EBIT) are $1.5 million but with expansion are expected to rise to $2.7 million. The income tax rate is 40 percent, and 200,000 shares of common stock are now outstanding. Common stock can be sold at $50 per share under the first financing option, which translates into 100,000 additional shares of stock.

To determine the EBIT-EPS break-even, or indifference, points among the various financing alternatives, we begin by calculating earnings per share, EPS, for some hypothetical level of EBIT using the following formula:

\[
EPS = \frac{(EBIT - I)(1 - t) - PD}{NS}
\]  

where 
- \( I \) = annual interest paid
- \( PD \) = annual preferred dividend paid
- \( t \) = corporate tax rate
- \( NS \) = number of shares of common stock outstanding

Suppose we wish to know what earnings per share would be under the three alternative additional-financing plans if EBIT were $2.7 million. The calculations are shown in Table 16.3. Note that interest on debt is deducted before taxes, whereas preferred stock dividends are deducted after taxes. As a result, earnings available to common shareholders (EACS) are higher under the debt alternative than they are under the preferred stock alternative, despite the fact that the interest rate on debt is higher than the preferred stock dividend rate.

**EBIT-EPS Chart.** Given the information in Table 16.3, we are able to construct an EBIT-EPS break-even chart similar to the one for operating leverage. On the horizontal axis we plot earnings before interest and taxes, and on the vertical axis we plot earnings per share. For each financing alternative, we must draw a straight line to reflect EPS for all possible levels of EBIT. Because two points determine a straight line, we need two data points for each financing alternative. The first is the EPS calculated for some hypothetical level of EBIT. For the expected $2.7 million level of EBIT, we see in Table 16.3 that earnings per share are $5.40, $6.30, and $5.35 for the common stock, debt, and preferred stock financing alternatives. We simply plot
these earnings per share levels to correspond with the $2.7 million level of EBIT. Technically, it does not matter which hypothetical level of EBIT we choose for calculating EPS. On good graph paper one EBIT level is as good as the next. However, it does seem to make common sense to choose the most likely, or expected, EBIT level rather than some level not too likely to occur.

The second data point – chosen chiefly because of its ease of calculation – is where EPS is zero. This is simply the EBIT necessary to cover all fixed financial costs for a particular financing plan, and it is plotted on the horizontal axis. We can make use of Eq. (16.10) to determine the horizontal axis intercept under each alternative. We simply set the numerator in the equation equal to zero and solve for EBIT. For the common stock alternative we have

\[
0 = (EBIT - I)(1 - t) - PD
\]

\[
= (EBIT - 0)(1 - 0.40) - 0
\]

\[
EBIT = 0/(0.60) = 0
\]

Notice that there are no fixed financing costs whatsoever (on either old or new financing). Therefore, EPS equals zero at zero EBIT. For the debt alternative we have

\[
0 = (EBIT - I)(1 - t) - PD
\]

\[
= (EBIT - 600,000)(1 - 0.40) - 0
\]

\[
EBIT = 600,000/(0.60) = 600,000
\]

Thus the after-tax interest charge divided by 1 minus the tax rate gives us the EBIT necessary to cover these interest payments. In short, we must have $600,000 to cover interest charges, so $600,000 becomes the horizontal axis intercept. Finally, for the preferred stock alternative we have

\[
0 = (EBIT - I)(1 - t) - PD
\]

\[
= (EBIT - 0)(1 - 0.40) - 550,000
\]

\[
EBIT = 550,000/(0.60) = 916,667
\]

We divide total annual preferred dividends by 1 minus the tax rate to obtain the EBIT necessary to cover these dividends. Thus we need $916,667 in EBIT to cover $550,000 in preferred stock dividends, assuming a 40 percent tax rate. Again, preferred dividends are deducted after taxes, so it takes more in before-tax earnings to cover them than it does to cover interest. Given the horizontal axis intercepts and earnings per share for some hypothetical level of EBIT (like the “expected” EBIT), we draw a straight line through each set of data points. The break-even, or indifference, chart for Cherokee Tire Company is shown in Figure 16.3.

We see from Figure 16.3 that the earnings per share indifference point between the debt and common stock additional-financing alternatives is $1.8 million in EBIT. If EBIT is below that point, the common stock alternative will provide higher earnings per share. Above that point the debt alternative produces higher earnings per share. The indifference point between the preferred stock and the common stock alternative is $2.75 million in EBIT. Above that point, the preferred stock alternative produces more favorable earnings per share. Below that point, the common stock alternative leads to higher earnings per share. Note that

\[3\text{If some of the firm’s pre-expansion financing had involved fixed costs, the horizontal intercept for the common stock financing alternative would not have been zero. It is only because } I \text{ and } PD \text{ are both zero in Eq. (16.11) that we get a zero value for EBIT.}
\]

\[4\text{Actually, }$1.8 \text{ million in EBIT is more accurately referred to as a “break-even point” rather than an “indifference point.” The financial manager will probably not be truly indifferent between the two alternative financing plans at that level of EBIT. Though both plans do produce the same level of EPS at }$1.8 \text{ million in EBIT, they do not do so by incurring the same level of financial risk – an issue that we will take up shortly. However, “indifference point” is part of the terminology common to EBIT-EPS analysis, so we need to be familiar with it.}
\]
there is no indifference point between the debt and preferred stock alternatives. The debt alternative dominates for all levels of EBIT and by a constant amount of earnings per share, namely 95 cents.

**Indifference Point Determined Mathematically.** The indifference point between two alternative financing methods can be determined mathematically by first using Eq. (16.10) to express \( \text{EPS} \) for each alternative and then setting these expressions equal to each other as follows:

\[
\frac{(EBIT_{1,2} - I_1)(1 - t) - PD_1}{NS_1} = \frac{(EBIT_{1,2} - I_2)(1 - t) - PD_2}{NS_2}
\]

where \( EBIT_{1,2} \) = EBIT indifference point between the two alternative financing methods that we are concerned with – in this case, methods 1 and 2

\( I_1, I_2 \) = annual interest paid under financing methods 1 and 2

\( PD_1, PD_2 \) = annual preferred stock dividend paid under financing methods 1 and 2

\( t \) = corporate tax rate

\( NS_1, NS_2 \) = number of shares of common stock to be outstanding under financing methods 1 and 2

Suppose that we wish to determine the indifference point between the common stock and debt-financing alternatives in our example. We would have

\[
\frac{(EBIT_{1,2} - 0)(1 - 0.40) - 0}{300,000} = \frac{(EBIT_{1,2} - 0.60)(1 - 0.40) - 0}{200,000}
\]

Cross multiplying and rearranging, we obtain

\[
(EBIT_{1,2})(0.60)(200,000) = (EBIT_{1,2})(0.60)(300,000) - (0.60)(600,000)(300,000)
\]
\[
(EBIT_{1,2})(60,000) = 108,000,000,000
\]
\[
EBIT_{1,2} = 1,800,000
\]

The EBIT-EPS indifference point, where earnings per share for the two methods of financing are the same, is $1.8 million. This amount can be verified graphically in Figure 16.3. Thus indifference points can be determined both graphically and mathematically.
Effect on Risk. So far our concern with EBIT-EPS analysis has been only with what happens to the return to common shareholders as measured by earnings per share. We have seen in our example that, if EBIT is above $1.8 million, debt financing is the preferred alternative from the standpoint of earnings per share. We know from our earlier discussion, however, that the impact on expected return is only one side of the coin. The other side is the effect that financial leverage has on risk. An EBIT-EPS chart does not permit a precise analysis of risk. Nevertheless, certain generalizations are possible. For one thing, the financial manager should compare the indifference point between two alternatives, such as debt financing versus common stock financing, with the most likely level of EBIT. The higher the expected level of EBIT, assuming that it exceeds the indifference point, the stronger the case that can be made for debt financing, all other things the same.

In addition, the financial manager should assess the likelihood of future EBITs actually falling below the indifference point. As before, our estimate of expected EBIT is $2.7 million. Given the business risk of the company and the resulting possible fluctuations in EBIT, the financial manager should assess the probability of EBITs falling below $1.8 million. If the probability is negligible, the use of the debt alternative will be supported. On the other hand, if EBIT is presently only slightly above the indifference point and the probability of EBITs falling below this point is high, the financial manager may conclude that the debt alternative is too risky.

This notion is illustrated in Figure 16.4, where two probability distributions of possible EBITs are superimposed on the indifference chart first shown in Figure 16.3. In Figure 16.4, however, we focus on only the debt and common stock alternatives. For the safe (peaked) distribution, there is virtually no probability that EBIT will fall below the indifference point. Therefore we might conclude that debt should be used, because the effect on shareholder return is substantial, whereas risk is negligible. For the risky (flat) distribution, there is a significant probability that EBIT will fall below the indifference point. In this case, the financial manager may conclude that the debt alternative is too risky.

In summary, the greater the level of expected EBIT above the indifference point and the lower the probability of downside fluctuation, the stronger the case that can be made for the
use of debt financing. EBIT-EPS break-even analysis is but one of several methods used for
determining the appropriate amount of debt a firm might carry. No one method of analysis
is satisfactory by itself. When several methods of analysis are undertaken simultaneously,
however, generalizations are possible.

**Degree of Financial Leverage (DFL)**

A quantitative measure of the sensitivity of a firm’s earnings per share to a change in the firm’s
operating profit is called the degree of financial leverage (DFL). The degree of financial lever-
age at a particular level of operating profit is simply the percentage change in earnings per
share over the percentage change in operating profit that causes the change in earnings per share. Thus,

\[
\text{DFL at EBIT of } X \text{ dollars} = \frac{\text{Percentage change in earnings per share (EPS)}}{\text{Percentage change in operating profit (EBIT)}}
\]  

(16.13)

Whereas Eq. (16.13) is useful for defining DFL, a simple alternative formula derived from
Eq. (16.13) is more useful for actually computing DFL values:

\[
\text{DFL of } EBIT \text{ of } X \text{ dollars} = \frac{\text{EBIT}}{\text{EBIT} - I - [PD/(1-t)]}
\]  

(16.14)

Equation (16.14) states that DFL at a particular level of operating profit is calculated by dividing
operating profit by the dollar difference between operating profit and the amount of
before-tax operating profit necessary to cover total fixed financing costs. (Remember, it takes
more in before-tax earnings to cover preferred dividends than it does to cover interest: hence
we need to divide preferred dividends by 1 minus the tax rate in our formula.)

For our example firm, using the debt-financing alternative at $2.7 million in EBIT, we have

\[
\text{DFL of }$2.7 \text{ million} = \frac{2,700,000}{2,700,000 - 600,000} = 1.29
\]

For the preferred stock financing alternative, the degree of financial leverage is

\[
\text{DFL of }$2.7 \text{ million} = \frac{2,700,000}{2,700,000 - [550,000/(0.60)]} = 1.51
\]

Interestingly, although the stated fixed cost involved with the preferred stock financing alter-
native is lower than that for the debt alternative ($550,000 versus $600,000), the DFL is greater
under the preferred stock option than under the debt option. This is because of the tax
deductibility of interest and the nondeductibility of preferred dividends. It is often argued that
preferred stock financing is of less risk than debt financing for the issuing firm. With regard
to the risk of cash insolvency, this is probably true. But the DFL tells us that the relative vari-
ability of EPS will be greater under the preferred stock financing arrangement, everything else
being equal. This discussion naturally leads us to the topic of financial risk and its relation-
ship to the degree of financial leverage.

**DFL and Financial Risk**

Financial Risk. Broadly speaking, financial risk encompasses both the risk of possible insolvency
and the added variability in earnings per share that is induced by the use of financial
leverage. As a firm increases the proportion of fixed cost financing in its capital structure,
fixed cash outflows increase. As a result, the probability of cash insolvency increases. To
illustrate this aspect of financial risk, suppose that two firms differ with respect to financial
leverage but are identical in every other respect. Each has expected annual cash earnings before interest and taxes of $80,000. Firm A has no debt. Firm B has $200,000 worth of 15 percent perpetual bonds outstanding. Thus the total annual fixed financial charges for Firm B are $30,000, whereas Firm A has no fixed financial charges. If cash earnings for both firms happen to be 75 percent lower than expected, namely $20,000, firm B will be unable to cover its financial charges with cash earnings. We see, then, that the probability of cash insolvency increases with the financial charges incurred by the firm.

The second aspect of financial risk involves the relative dispersion of earnings per share. To illustrate, suppose that the expected future EBITs for firm A and firm B are random variables where the expected values of the probability distributions are each $80,000 and the standard deviations $40,000. As before, firm A has no debt but rather 4,000 shares of $10-par-value common stock outstanding. Firm B has $200,000 in 15 percent bonds and 2,000 shares of $10-par-value common stock outstanding.

Frame A in Table 16.4 shows that the expected earnings available to common shareholders for firm A equals $48,000, while for firm B this figure equals only $30,000. Dividing expected earnings available to common shareholders by the number of shares of common stock outstanding, however, reveals that firm B has a higher expected earnings per share than firm A: that is, $15 and $12, respectively. The standard deviation of earnings per share is determined to be $6 for firm A and $12 for firm B.

**Total Firm Risk Equals Business Risk Plus Financial Risk.** The coefficient of variation of earnings per share, which is simply the standard deviation divided by the expected value, gives us a measure of the relative dispersion of earnings per share. We use this statistic as a measure of total firm risk. In frame B of Table 16.4 we see that for firm A, the 100-percent-equity situation, the coefficient of variation of earnings per share is 0.50. Notice that this figure is exactly equal to the firm’s coefficient of variation of earnings before interest and taxes. What this says is that even in the absence of financial leverage, the firm’s shareholders are still exposed to risk – business risk. A good quantitative measure of a firm’s relative amount of business risk is thus the coefficient of variation of EBIT. For firm B, the

### Table 16.4

**Effect of financial leverage example showing that financial leverage affects both the level and variability of earnings per share**

<table>
<thead>
<tr>
<th></th>
<th>FIRM A (100% EQUITY)</th>
<th>FIRM B (50% EQUITY)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frame A: Forecast income statement information</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expected earnings before interest and taxes [(E(\text{EBIT}))]</td>
<td>$80,000</td>
<td>$80,000</td>
</tr>
<tr>
<td>Interest (I)</td>
<td></td>
<td>$30,000</td>
</tr>
<tr>
<td>Expected earnings before taxes [(E(\text{EBT}))]</td>
<td>$80,000</td>
<td>$50,000</td>
</tr>
<tr>
<td>Expected taxes [(E(\text{EBT}) \times t)]</td>
<td>32,000</td>
<td>20,000</td>
</tr>
<tr>
<td>Expected earnings available to common shareholders [(E(\text{EACS}))]</td>
<td>$48,000</td>
<td>$30,000</td>
</tr>
<tr>
<td>Number of shares of common stock outstanding (NS)</td>
<td>4,000</td>
<td>2,000</td>
</tr>
<tr>
<td>Expected earnings per share [(E(\text{EPS}))]</td>
<td>$12.00</td>
<td>$15.00</td>
</tr>
<tr>
<td><strong>Frame B: Risk components</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard deviation of earnings per share ((\sigma_{\text{EPS}}))^*</td>
<td>$6.00</td>
<td>$12.00</td>
</tr>
<tr>
<td>Coefficient of variation of earnings before interest and taxes [(\sigma_{\text{EBIT}}/E(\text{EBIT}))]</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>DFL [\text{DFL} = \frac{\text{EBIT} \times (1 - t)}{\text{EBIT} - I - PD/(1 - t)}]</td>
<td>1.00</td>
<td>1.60</td>
</tr>
<tr>
<td>Coefficient of variation of earnings per share [\sigma_{\text{EPS}}/E(\text{EPS})] or [\sigma_{\text{EBIT}}/E(\text{EBIT}) \times \text{DFL}_{\text{EBIT}}]</td>
<td>0.50</td>
<td>0.80</td>
</tr>
</tbody>
</table>

^*For any random variable \(X\), the \(\sigma_{ax + bx} = (b)\sigma_x\); therefore \(\sigma_{\text{EPS}} = (1/\text{number of shares of common stock outstanding})(1 - t)(\sigma_{\text{EBIT}})\). Example for 50% debt: \((1/2,000)(1 - 0.40)(40,000) = 12.00\).
50-percent-debt situation, the coefficient of variation of earnings per share is 0.80. Because firm B is exactly like firm A except for the use of financial leverage, we can use the difference between the coefficients of variation of earnings per share for firm B and firm A: that is, 0.80 − 0.50 = 0.30, as a measure of the added variability in earnings per share for firm B that is induced by the use of leverage; in short, this difference is a measure of financial risk. Equivalently, this measure of financial risk equals the difference between firm B’s coefficient of variation of earnings per share and its coefficient of variation of earnings before interest and taxes.

**Take Note**

In summary, then
- **Total firm risk** = business risk + financial risk.
- The coefficient of variation of earnings per share, $CV_{EPS}$, is a measure of relative total firm risk: $CV_{EPS} = \sigma_{EPS}/E(\text{EPS})$.
- The coefficient of variation of earnings before interest and taxes, $CV_{EBIT}$, is a measure of relative business risk: $CV_{EBIT} = \sigma_{EBIT}/E(\text{EBIT})$.
- The difference, therefore, between the coefficient of variation of earnings per share ($CV_{EPS}$) and the coefficient of variation of earnings before interest and taxes ($CV_{EBIT}$) is a measure of relative financial risk: $(CV_{EPS} - CV_{EBIT})$.

We have seen from Table 16.4 that total firm risk in our example, as measured by the coefficient of variation of earnings per share, is higher under the 50-percent-bond financing than it is under the 100-percent-equity financing. However, the expected level of earnings per share is also higher. We witness, once again, the kind of risk-return trade-off that characterizes most financial leverage decisions.

**DFL Magnifies Risk.** Our measure of relative total firm risk, the coefficient of variation of earnings per share, can be calculated directly by dividing the standard deviation of earnings per share by the expected earnings per share. However, given the assumptions behind our example, it can be shown that this measure is also equal to the coefficient of variation of earnings before interest and taxes times the degree of financial leverage at the expected EBIT level.

Firm A, in our example, has no financial leverage and a resulting DFL equal to 1: in short, there is no magnification of business risk as measured by the $CV_{EBIT}$. For firm A, then, $CV_{EPS}$ equals $CV_{EBIT}$, and thus its total firm risk is equal to its business risk. Firm B’s $CV_{EPS}$, on the other hand, is equal to its $CV_{EBIT}$ (its measure of business risk) times 1.6 (its DFL at the expected EBIT). Thus, for firms employing financial leverage, their DFL will act to magnify the impact of business risk on the variability of earnings per share. So, although DFL is not synonymous with financial risk, its magnitude does determine the relative amount of additional risk induced by the use of financial leverage. As a result, firms with high business risk will often employ a financing mix that entails a limited DFL, and vice versa.

**Proof:**

\[
\frac{\sigma_{EBIT}}{E(\text{EPS})} = \frac{(\ln(1 - t))(\sigma_{EBIT})}{E(\text{EBIT})(1 - t) - I(1 - t) - PD)/NS} = \frac{\sigma_{EBIT}}{E(\text{EBIT}) - I - [PD/(1 - t)]} = \sigma_{EBIT} \times \frac{E(\text{EBIT})}{E(\text{EBIT}) - I - [PD/(1 - t)]} = CV_{EBIT} \times \text{DFL}_{EBIT}
\]
When financial leverage is combined with operating leverage, the result is referred to as total (or combined) leverage. The effect of combining financial and operating leverage is a two-step magnification of any change in sales into a larger relative change in earnings per share. A quantitative measure of this total sensitivity of a firm’s earnings per share to a change in the firm’s sales is called the degree of total leverage (DTL).

### Degree of Total Leverage (DTL)

The degree of total leverage of a firm at a particular level of output (or sales) is equal to the percentage change in earnings per share over the percentage change in output (or sales) that causes the change in earnings per share. Thus,

\[
\text{Degree of total leverage (DTL) at } Q \text{ units (or } S \text{ dollars) of output (or sales)} = \frac{\text{Percentage change in earnings per share (EPS)}}{\text{Percentage change in output (or sales)}} \quad [16.15]
\]

Computationally, we can make use of the fact that the degree of total leverage is simply the product of the degree of operating leverage and the degree of financial leverage as follows:

\[
\text{DTL}_Q \text{ units (or } S \text{ dollars)} = \text{DOL}_Q \text{ units (or } S \text{ dollars)} \times \text{DFL} \text{ of } X \text{ dollars} \quad [16.16]
\]

In addition, multiplying alternative DOLs, Eqs. (16.8) and (16.9), by DFL, Eq. (16.14), gives us

\[
\text{DTL}_Q \text{ units} = \frac{Q(P - V)}{Q(P - V) - FC - I - [PD/(1 - t)]} \quad [16.17]
\]

\[
\text{DTL}_S \text{ dollars of sales} = \frac{\text{EBIT} + FC}{\text{EBIT} - I - [PD/(1 - t)]} \quad [16.18]
\]

These alternative equations tell us that for a particular firm the greater the before-tax financial costs, the greater the degree of total leverage over what it would be in the absence of financial leverage.

Suppose that our bicycle-helmet manufacturing firm used to illustrate operating leverage has $200,000 in debt at 8 percent interest. Recall that the selling price is $50 a unit, variable operating costs are $25 a unit, and annual fixed operating costs are $100,000. Assume that the tax rate is 40 percent, and that we wish to determine the degree of total leverage at 8,000 units of production and sales. Therefore, using Eq. (16.17), we have

\[
\text{DTL}_{8,000 \text{ units}} = \frac{8,000($50 - $25)}{8,000($50 - $25) - $100,000 - $16,000} = 2.38
\]

Thus a 10 percent increase in the number of units produced and sold would result in a 23.8 percent increase in earnings per share.

Stating the degree of total leverage for our example firm in terms of the product of its degree of operating leverage times its degree of financial leverage, we get

\[
\text{DOL}_{8,000 \text{ units}} \times \text{DFL} \text{ of } $100,000 = \text{DTL}_{8,000 \text{ units}}
\]

\[
\frac{8,000($50 - $25)}{8,000($50 - $25) - $100,000} \times \frac{\text{EBIT} of $100,000}{\text{EBIT} - I - [PD/(1 - t)]} = 2.38
\]

\[
2.00 \times 1.19 = 2.38
\]

In the absence of financial leverage, our firm’s degree of total leverage would have been equal to its degree of operating leverage for a value of 2 (remember, DFL for a firm with no
financial leverage equals 1). We see, however, that the firm’s financial leverage magnifies its DOL figure by a factor of 1.19 to produce a degree of total leverage equal to 2.38.

**DTL and Total Firm Risk**

Operating leverage and financial leverage can be combined in a number of different ways to obtain a desirable degree of total leverage and level of total firm risk. High business risk can be offset with low financial risk and vice versa. The proper overall level of firm risk involves a trade-off between total firm risk and expected return. This trade-off must be made in keeping with the objective of maximizing shareholder value. The discussion, so far, is meant to show how certain tools can be employed to provide information on the two types of leverage – operating and financial – and their combined effect.

**Cash-Flow Ability to Service Debt**

When trying to determine the appropriate financial leverage for a firm, we would also analyze the cash-flow ability of the firm to service fixed financial charges. The greater the dollar amount of senior securities that the firm issues and the shorter their maturity, the greater the fixed financial charges of the firm. These charges include principal and interest payments on debt, financial lease payments, and preferred stock dividends. Before taking on additional fixed financial charges, the firm should analyze its expected future cash flows, because fixed financial charges must be met with cash. The inability to meet these charges, with the exception of preferred stock dividends, may result in financial insolvency. The greater and more stable the expected future cash flows of the firm, the greater the debt capacity of the company.

**Coverage Ratios**

Among the ways in which we can gain knowledge about the debt capacity of a firm is through an analysis of coverage ratios. These ratios, as you may remember from Chapter 6, are designed to relate the financial charges of a firm to the firm’s ability to service, or cover, them. In the computation of these ratios, one typically uses earnings before interest and taxes as a rough measure of the cash flow available to cover fixed financial charges. Perhaps the most widely used coverage ratio is the interest coverage ratio, or times interest earned. This ratio is simply earnings before interest and taxes for a particular period divided by interest charges for the period:

\[
\text{Interest coverage ratio} = \frac{\text{Earnings before interest and taxes (EBIT)}}{\text{Interest expense}}
\]  \hspace{1cm} \text{(16.19)}

Suppose, for example, that the most recent annual earnings before interest and taxes for a company were $6 million and annual interest payments on all debt obligations were $1.5 million. Then EBIT would “cover” interest charges four times. This tells us that EBIT can drop by as much as 75 percent and the firm will still be able to cover interest payments out of earnings.

An interest coverage ratio of only 1 indicates that earnings are just sufficient to satisfy the interest burden. Generalizations about what is a proper interest coverage ratio are inappropriate unless reference is made to the type of business in which the firm is engaged. In a highly stable business, a relatively low interest coverage ratio may be appropriate, whereas it may not be appropriate in a highly cyclical business.

Note that the interest coverage ratio tells us nothing about the firm’s ability to meet principal payments on its debts. The inability to meet a principal payment constitutes the same legal default as failure to meet an interest payment. Therefore it is useful to compute the coverage ratio for the full debt-service burden. This ratio is...
Here principal payments are adjusted upward for the tax effect. The reason is that EBIT represents earnings before tax. Because principal payments are not deductible for tax purposes, they must be paid out of after-tax earnings. Therefore we must adjust principal payments so that they are consistent with EBIT. If principal payments in our previous example were $1 million per annum and the tax rate were 40 percent, the debt-service coverage ratio would be $6 million \div (1.5 million + 1 million) = 1.89. A coverage ratio of 1.89 means that EBIT can fall by only 47 percent before earnings coverage is insufficient to service the debt. Obviously, the closer the debt-service coverage ratio is to 1, the worse things are, all other things the same. However, even with this coverage ratio being less than 1, a company may still be able to meet its obligations if it can renew some of its debt when principal comes due or if assets are sold.

Part of the overall analysis of the financial risk associated with financial leverage should focus on the firm’s ability to service total fixed charges. Lease financing is not debt per se, but its impact on cash flows is exactly the same as the payment of interest and principal on a debt obligation. (See Chapter 21 for an analysis of lease financing.) Annual financial lease payments, therefore, should be added to the numerator and denominator of Eq. (16.20) in order to properly reflect the total cash-flow burden associated with financing.

As with the interest coverage ratio, “rules of thumb” generalizations about what constitutes a good or bad debt-service ratio are often inappropriate. What constitutes a good or bad ratio varies according to the business risk of the firm. This fact is illustrated in Figure 16.5, which shows the probability distributions of EBIT for two hypothetical companies. The expected value of EBIT is the same for both companies, as is the debt-service burden as described by the denominator in Eq. (16.20). Therefore the debt-service coverage ratios are also the same, namely $100,000/$60,000 = 1.67. Company A, however, has much more business risk, as

\[ \text{Debt-service coverage} = \frac{\text{Earnings before interest and taxes (EBIT)}}{\text{Interest expense} + \frac{\text{Principal payments}}{1 - \text{Tax rate}}} \]
shown in the greater variability of its EBIT. The probability that EBIT will fall below the
debt-service burden is depicted by the shaded areas in the figure. We see that this probability
is much greater for company A than it is for company B. Though a debt-service coverage
ratio of 1.67 may be appropriate for company B, it may not be appropriate for company A.
Simply put, a company with stable cash flows is better able to take on relatively more fixed
charges.

Ultimately, one wants to make generalizations about the appropriate amount of debt (and
leases) for a firm to have in its financing mix. It is clear that the ability of a going-concern firm
to service debt over the long run is tied to earnings. Therefore coverage ratios are an import-
ant tool of analysis. However, they are but one tool by which a person is able to reach con-
clusions with respect to determining an appropriate financing mix for the firm. Coverage
ratios, like all ratios, are subject to certain limitations and, consequently, cannot be used as a
sole means for determining a firm’s financing. The fact that EBIT falls below the debt-service
burden does not spell immediate doom for the company. Often alternative sources of funds,
including renewal of the loan, are available, and these sources must be considered.

---

**Probability of Cash Insolvency**

The vital question for the firm is not so much whether a coverage ratio will fall below 1 but
rather, what are the chances of cash insolvency? Fixed-charge financing adds to the firm’s
danger of cash insolvency. Therefore the answer depends on whether all sources of payment –
earnings, cash, a new financing arrangement, or the sale of assets – are collectively deficient.
A coverage ratio tells only part of the story. To address the broad question of cash insolvency,
we must obtain information on the possible deviation of actual cash flows from those that are
expected. As we discussed in Chapter 7, cash budgets can be prepared for a range of possible
outcomes, with a probability attached to each outcome. This information is extremely valu-
able to the financial manager in evaluating the ability of the firm to meet fixed obligations.
Not only are expected earnings taken into account in determining this ability, but other
cash-flow factors as well – the purchase or sale of assets, the liquidity of the firm, dividend
payments, and seasonal patterns. Given the probabilities of particular cash-flow sequences,
the financial manager is able to determine the amount of fixed financing charges the company
can undertake while still remaining within insolvency limits tolerable to management.

Management may feel that a 5 percent probability of being out of cash is the maximum
that it can tolerate and that this probability corresponds to a cash budget prepared under
pessimistic assumptions. In this case, debt might be undertaken up to the point where the
cash balance under the pessimistic cash budget is just sufficient to cover the fixed charges
associated with the debt. In other words, debt would be increased to the point at which the
additional cash drain would cause the probability of cash insolvency to equal the risk toler-
ance specified by management. Note that the method of analysis simply provides a means for
assessing the effect of increases in debt on the risk of cash insolvency. On the basis of this
information, management would arrive at the most appropriate level of debt.

The analysis of the cash-flow ability of the firm to service fixed financial charges is perhaps
the best way to analyze financial risk, but there is a real question as to whether all (or most)
of the participants in the financial markets analyze a company in this manner. Sophisticated
lenders and institutional investors certainly analyze the amount of fixed financial charges and
evaluate financial risk in keeping with the ability of the firm to service these charges. However,
individual investors may judge financial risk more by book value proportions of debt and
equity. There may or may not be a reasonable correspondence between the ratio of debt to
equity and the amount of fixed charges relative to the firm’s cash-flow ability to service these
charges. Some firms may have relatively high ratios of debt to equity but substantial cash-flow
ability to service debt. Consequently, the analysis of debt-to-equity ratios alone can be deceiv-
ing, and an analysis of the magnitude and stability of cash flows relative to fixed financial
charges is extremely important in determining the appropriate financing mix for the firm.
Other Methods of Analysis

- **Comparison of Capital Structure Ratios**

Another method of analyzing the appropriate financing mix for a company is to evaluate the capital structure of other companies having similar business risk. Companies used in this comparison are most often those in the same industry. If the firm is contemplating a capital structure significantly out of line with that of similar companies, it is conspicuous in the marketplace. This is not to say that the firm is wrong. Other companies in the industry may be too conservative in their use of debt. The optimal capital structure for all companies in the industry might call for a higher proportion of debt to equity than the industry average. As a result, the firm may be able to justify more debt than the industry average. If the firm’s financial leverage is noticeably out of line in either direction, it should be prepared to justify its position, because investment analysts and creditors tend to evaluate companies by industry.

There are wide variations in the use of financial leverage across business firms. A good deal of the variation is removed, however, if one groups firms by industry classification, because there is a tendency for the firms in an industry to cluster when it comes to debt ratios. For selected industries, the debt-to-net-worth ratios for a recent period looked as follows:

<table>
<thead>
<tr>
<th>INDUSTRY</th>
<th>DEBT TO NET WORTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optical instruments and lenses (manufac.)</td>
<td>1.2</td>
</tr>
<tr>
<td>Pharmaceutical preparations (manufac.)</td>
<td>1.2</td>
</tr>
<tr>
<td>Meat packing plants (manufac.)</td>
<td>1.8</td>
</tr>
<tr>
<td>Electronic components (manufac.)</td>
<td>1.8</td>
</tr>
<tr>
<td>Carpets and rugs (manufac.)</td>
<td>1.9</td>
</tr>
<tr>
<td>Wood kitchen cabinets (manufac.)</td>
<td>2.9</td>
</tr>
<tr>
<td>Gasoline service stations (retail)</td>
<td>3.2</td>
</tr>
<tr>
<td>General contractors (single-family houses)</td>
<td>5.0</td>
</tr>
</tbody>
</table>

Whereas optical instruments manufacturers and pharmaceutical companies do not employ much financial leverage, general contractors make extensive use of debt in financing projects. So when making capital structure comparisons, look at other companies in the same industry. In short, compare apples with apples as opposed to apples with oranges.

- **Surveying Investment Analysts and Lenders**

The firm may profit by also talking with investment analysts, institutional investors, and investment bankers to obtain their views on appropriate amounts of financial leverage. These analysts examine many companies and are in the business of recommending stocks. They therefore have an influence on the financial market. Their judgments with respect to how the market evaluates financial leverage may be very worthwhile. Similarly, a firm may wish to interview lenders to see how much debt it can undertake before the cost of borrowing is likely to rise. Finally, the management of a company may develop a “feel” for what has happened to the market price of the company’s stock when it has issued debt in the past.

- **Security Ratings**

The financial manager must consider the effect of a financing alternative on its security rating. Whenever a company sells a debt or preferred stock issue to public investors, as opposed to private lenders such as banks, it must have the issue rated by one or more rating services. The principal rating agencies are Moody’s Investors Service and Standard & Poor’s. The issuer of a new corporate security issue contracts with the agency to evaluate the issue as to quality, as well as to update the rating throughout the issue’s life. For this service, the issuer pays a fee. In addition, the rating agency charges subscribers to its rating publications. Whereas the
assignment of a rating for a new issue is current, changes in ratings of existing securities tend to lag the events that prompt the changes.

Both agencies use much the same letter grading. The ratings used by Moody’s and Standard & Poor’s, as well as brief descriptions, are shown in Table 16.5. In their ratings, the agencies attempt to rank issues in order of their perceived probability of default. The highest grade securities, judged to have negligible default risk, are rated triple-A.

Credit ratings in the top four categories (for Moody’s, Aaa to Baa; for Standard & Poor’s, AAA to BBB) are considered “investment grade” quality, whereas ratings in the other categories signify “speculative grade.” The ratings by the agencies are widely respected and are recognized by various government regulatory agencies as measures of default risk. In fact, many investors accept them without further investigation of the risk of default.

The rating agencies look at a number of things before assigning a grade: levels and trends in ratios of liquidity, debt, profitability, and coverage; the firm’s business risk, both historical and expected; present and likely future capital requirements; specific features associated with the instrument being issued; and, perhaps most important, the cash-flow ability of the firm to service interest and principal payments. If a public security offering is contemplated, the financial manager must be mindful of ratings when determining how much financial leverage is appropriate. If taking on additional debt lowers a firm’s security rating from an investment-grade to a speculative-grade category – thus making the security ineligible for investment by many institutional investors – the manager will want to factor this into account before making a decision.

**Combination of Methods**

We have seen that the variability of sales and production costs, coupled with operating leverage, affect the variability of operating profit and, thus, a firm’s business risk. In addition to incurring business risk, most firms consciously expose themselves to financial risk by employing financial leverage to greater or lesser degrees. Most of this chapter has been devoted to examining methods of analysis that can be brought to bear on the question: In light of the firm’s business risk, what is the appropriate amount of financial leverage for a company? The methods studied include undertaking EBIT-EPS analysis, assessing the cash-flow ability of the firm to service fixed financial charges, comparing capital structure ratios of other companies having similar business risk, surveying investment analysts and lenders, and
Financial leverage is the second step in a two-step profit-magnification process. In step one, operating leverage magnifies the effect of changes in sales on changes in operating profit. In step two, financial leverage can be used to further magnify the effect of any resulting changes in operating profit on changes in earnings per share.

- **Leverage** refers to the use of fixed costs in an attempt to increase (or lever up) profitability. Operating leverage is due to fixed operating costs associated with the production of goods or services, whereas financial leverage is due to the existence of fixed financing costs—in particular, interest on debt. Both types of leverage affect the level and variability of the firm’s after-tax earnings, and hence the firm’s overall risk and return.

- We can study the relationship between total operating costs and total revenues by using a break-even chart, which shows the relationship among total revenues, total operating costs, and operating profits for various levels of production and sales.

- The **break-even point** is the sales volume required so that total revenues and total costs are equal. It may be expressed in units or in sales dollars.

- A quantitative measure of the sensitivity of a firm’s operating profit to a change in the firm’s sales is called the **degree of operating leverage (DOL)**. The DOL of a firm at a particular level of output (or sales) is the percentage change in operating profit over the percentage change in output (or sales) that causes the change in profits. The closer a firm operates to its break-even point, the higher is the absolute value of its DOL.

- The degree of operating leverage contributes but one component of the overall business risk of the firm. The other principal factors giving rise to business risk are variability or uncertainty of sales and production costs. The firm’s degree of operating leverage magnifies the impact of these other factors on the variability of operating profits.

- **Financial leverage** is the second step in a two-step profit-magnification process. In step one, operating leverage magnifies the effect of changes in sales on changes in operating profit. In step two, financial leverage can be used to further magnify the effect of any resulting changes in operating profit on changes in earnings per share.

- **EBIT–EPS break-even, or indifference, analysis** is used to study the effect of financing alternatives on earnings per share. The break-even point is the EBIT level where EPS is the same for two (or more) alternatives. The higher the expected level of EBIT, assuming that it exceeds the indifference point, the stronger the case that can be made for debt financing, all other things the same. In addition, the financial manager should assess the likelihood of future EBITs actually falling below the indifference point.

- A quantitative measure of the sensitivity of a firm’s earnings per share to a change in the firm’s operating profit is called the **degree of financial leverage (DFL)**. The DFL at a particular level of operating profit is the percentage change in earnings per share over the percentage change in operating profit that causes the change in earnings per share.

- **Financial risk** encompasses both the risk of possible insolvency and the “added” variability in earnings per share that is induced by the use of financial leverage.

- When financial leverage is combined with operating leverage, the result is referred to as **total (or combined) leverage**. A quantitative measure of the total sensitivity of a firm’s earnings per share to a change in the firm’s sales is called the **degree of total leverage (DTL)**. The DTL of a firm at a particular level of output (or sales) is equal to the percentage change in earnings per share over the percentage change in output (or sales) that causes the change in earnings per share.

- When trying to determine the appropriate financial leverage for a firm, the cash-flow ability of the firm to service debt should be evaluated. The firm’s **debt capacity** can be assessed by analyzing coverage ratios.
Questions

1. Define operating leverage and the degree of operating leverage (DOL). How are the two related?

2. Classify the following short-run manufacturing costs as either typically fixed or typically variable. Which costs are variable at management’s discretion? Are any of these costs fixed in the long run?
   a. Insurance
   b. Direct labor
   c. Bad-debt loss
   d. R&D
   e. Advertising
   f. Raw materials
   g. Depletion
   h. Depreciation
   i. Maintenance

3. What would be the effect on the firm’s operating break-even point of the following individual changes?
   a. An increase in selling price
   b. An increase in the minimum wage paid to the firm’s employees
   c. A change from straight-line to accelerated depreciation
   d. Increased sales
   e. A liberalized credit policy to customers

4. Are there any businesses that are risk free?

5. Your friend, Jacques Fauxpas, suggests, “Firms with high fixed operating costs show extremely dramatic fluctuations in operating profits for any given change in sales volume.” Do you agree with Jacques? Why or why not?

6. You can have a high degree of operating leverage (DOL) and still have low business risk. Why? By the same token, you can have a low DOL and still have high business risk. Why?

7. Define financial leverage and the degree of financial leverage (DFL). How are the two related?

8. Discuss the similarities and differences between financial leverage and operating leverage.

9. Can the concept of financial leverage be analyzed quantitatively? Explain.

10. The EBIT-EPS chart suggests that the higher the debt ratio, the higher are the earnings per share for any level of EBIT above the indifference point. Why do firms sometimes choose financing alternatives that do not maximize EPS?

11. Why is the percentage of debt for an electric utility higher than that for the typical manufacturing company?

12. Is the debt-to-equity ratio a good proxy for financial risk as represented by the cash-flow ability of a company to service debt? Why or why not?

13. How can a company determine in practice whether it has too much debt? Too little debt?

14. How can coverage ratios be used to determine an appropriate amount of debt to employ? Are there any shortcomings to the use of these ratios?

15. In financial leverage, why not simply increase leverage as long as the firm is able to earn more on the employment of the funds thus provided than they cost? Would not earnings per share increase?

16. Describe how a company could determine its debt capacity by increasing its debt hypothetically until the probability of running out of cash reached some degree of tolerance.

17. How might a company’s bond rating influence a capital structure decision?
1. Stallings Specialty Paint Company has fixed operating costs of $3 million a year. Variable operating costs are $1.75 per half pint of paint produced, and the average selling price is $2 per half pint.
   a. What is the annual operating break-even point in half pints ($Q_{BE}$)? In dollars of sales ($S_{BE}$)?
   b. If variable operating costs decline to $1.68 per half pint, what would happen to the operating break-even point ($Q_{BE}$)?
   c. If fixed costs increase to $3.75 million per year, what would be the effect on the operating break-even point ($Q_{BE}$)?
   d. Compute the degree of operating leverage (DOL) at the current sales level of 16 million half pints.
   e. If sales are expected to increase by 15 percent from the current sales position of 16 million half pints, what would be the resulting percentage change in operating profit (EBIT) from its current position?

2. Gahlon Gearing, Ltd., has a DOL of 2 at its current production and sales level of 10,000 units. The resulting operating income figure is $1,000.
   a. If sales are expected to increase by 20 percent from the current 10,000-unit sales position, what would be the resulting operating profit figure?
   b. At the company’s new sales position of 12,000 units, what is the firm’s “new” DOL figure?

3. David Ding Baseball Bat Company currently has $3 million in debt outstanding, bearing an interest rate of 12 percent. It wishes to finance a $4 million expansion program and is considering three alternatives: additional debt at 14 percent interest (option 1), preferred stock with a 12 percent dividend (option 2), and the sale of common stock at $16 per share (option 3). The company currently has 800,000 shares of common stock outstanding and is in a 40 percent tax bracket.
   a. If earnings before interest and taxes are currently $1.5 million, what would be earnings per share for the three alternatives, assuming no immediate increase in operating profit?
   b. Develop a break-even, or indifference, chart for these alternatives. What are the approximate indifference points? To check one of these points, mathematically determine the indifference point between the debt plan and the common stock plan. What are the horizontal axis intercepts?
   c. Compute the degree of financial leverage (DFL) for each alternative at the expected EBIT level of $1.5 million.
   d. Which alternative do you prefer? How much would EBIT need to increase before the next alternative would be “better” (in terms of EPS)?

4. Show how to derive Eq. (16.8),

\[
DOL_{Q\text{units}} = \frac{Q(P - V)}{Q(P - V) - FC} = \frac{Q}{Q - Q_{BE}}
\]

from Eq. (16.7),

\[
\text{Degree of operating leverage (DOL) at } Q \text{ units of output (or sales)} = \frac{\text{Percentage change in operating profit (EBIT)}}{\text{Percentage change in output (or sales)}}
\]

5. Archimedes Torque and Gear Company has $7.4 million in long-term debt having the following payment schedule:
Archimedes’ common stock has a book value of $8.3 million and a market value of $6 million. The corporate tax rate, federal plus state, is 50 percent. Archimedes is in a cyclical business; its expected EBIT is $2 million, with a standard deviation of $1.5 million. The average debt-to-equity ratio of other companies in the industry is 0.47.

a. Determine the interest coverage and the debt-service coverage ratios for the company.
b. What are the probabilities that these two ratios will go below 1:1?
c. Does Archimedes have too much debt?

6. Aberez Company and Vorlas Vactor, Inc., have the following financial characteristics:

<table>
<thead>
<tr>
<th></th>
<th>Aberez Company</th>
<th>Industry Norm</th>
<th>Vorlas Vactor</th>
<th>Industry Norm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debt to equity</td>
<td>1.10</td>
<td>1.43</td>
<td>0.78</td>
<td>0.47</td>
</tr>
<tr>
<td>Bond rating</td>
<td>A</td>
<td>A</td>
<td>Ba</td>
<td>Baa</td>
</tr>
<tr>
<td>Interest coverage</td>
<td>6.10</td>
<td>5.70</td>
<td>7.30</td>
<td>7.10</td>
</tr>
<tr>
<td>Cash and marketable securities to total assets</td>
<td>0.08</td>
<td>0.07</td>
<td>0.10</td>
<td>0.13</td>
</tr>
</tbody>
</table>

On the basis of these data, which company has the greater degree of financial risk? Why?

Problems

1. The Andrea S. Fault Seismometer Company is an all-equity-financed firm. It earns monthly, after taxes, $24,000 on sales of $880,000. The tax rate of the company is 40 percent. The company’s only product, “The Desktop Seismometer,” sells for $200, of which $150 is variable cost.
   a. What is the company’s monthly fixed operating cost?
   b. What is the monthly operating break-even point in units? In dollars?
   c. Compute and plot the degree of operating leverage (DOL) versus quantity produced and sold for the following possible monthly sales levels: 4,000 units; 4,400 units; 4,800 units; 5,200 units; 5,600 units; and 6,000 units.
   d. What does the graph that you drew (see Part (c)) – and especially the company’s DOL at its current sales figure – tell you about the sensitivity of the company’s operating profit to changes in sales?

2. What would be the effect of the following on the break-even point of the Andrea S. Fault Company (Problem 1)?
   a. An increase in selling price of $50 per unit (assume that sales volume remains constant)
   b. A decrease in fixed operating costs of $20,000 per month
   c. A decrease in variable costs of $10 per unit and an increase in fixed costs of $60,000 per month

3. The Crazy Horse Hotel has a capacity to stable 50 horses. The fee for stabling a horse is $100 per month. Maintenance, depreciation, and other fixed operating costs total $1,200 per month. Variable operating costs per horse are $12 per month for hay and bedding and $8 per month for grain.
   a. Determine the monthly operating break-even point (in horses stabled).
   b. Compute the monthly operating profit if an average of 40 horses are stabled.

4. Cybernauts, Ltd., is a new firm that wishes to determine an appropriate capital structure. It can issue 16 percent debt or 15 percent preferred stock. The total capitalization of the company will be $5 million, and common stock can be sold at $20 per share. The company
is expected to have a 50 percent tax rate (federal plus state). Four possible capital structures being considered are as follows:

<table>
<thead>
<tr>
<th>PLAN</th>
<th>DEBT</th>
<th>PREFERRED</th>
<th>EQUITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>2</td>
<td>30%</td>
<td>0%</td>
<td>70%</td>
</tr>
<tr>
<td>3</td>
<td>50%</td>
<td>0%</td>
<td>50%</td>
</tr>
<tr>
<td>4</td>
<td>50%</td>
<td>20%</td>
<td>30%</td>
</tr>
</tbody>
</table>

a. Construct an EBIT-EPS chart for the four plans. (EBIT is expected to be $1 million.) Be sure to identify the relevant indifference points and determine the horizontal-axis intercepts.

b. Using Eq. (16.12), verify the indifference point on your graph between plans 1 and 3 and between plans 3 and 4.

c. Compute the degree of financial leverage (DFL) for each alternative at an expected EBIT level of $1 million.

d. Which plan is best? Why?

5. Hi-Grade Regulator Company currently has 100,000 shares of common stock outstanding with a market price of $60 per share. It also has $2 million in 6 percent bonds. The company is considering a $3 million expansion program that it can finance with all common stock at $60 a share (option 1), straight bonds at 8 percent interest (option 2), preferred stock at 7 percent (option 3), and half common stock at $60 per share and half 8 percent bonds (option 4).

a. For an expected EBIT level of $1 million after the expansion program, calculate the earnings per share for each of the alternative methods of financing. Assume a tax rate of 50 percent.

b. Construct an EBIT-EPS chart. Calculate the indifference points between alternatives. What is your interpretation of them?

6. Hi-Grade Regulator Company (see Problem 5) expects the EBIT level after the expansion program to be $1 million, with a two-thirds probability that it will be between $600,000 and $1,400,000.

a. Which financing alternative do you prefer? Why?

b. Suppose that the expected EBIT level were $1.5 million and that there is a two-thirds probability that it would be between $1.3 million and $1.7 million. Which financing alternative would you prefer? Why?

7. Fazio Pump Corporation currently has 1.1 million shares of common stock outstanding and $8 million in debt bearing an interest rate of 10 percent on average. It is considering a $5 million expansion program financed with common stock at $20 per share being realized (option 1), or debt at an interest rate of 11 percent (option 2), or preferred stock with a 10 percent dividend rate (option 3). Earnings before interest and taxes (EBIT) after the new funds are raised are expected to be $6 million, and the company’s tax rate is 35 percent.

a. Determine likely earnings per share after financing for each of the three alternatives.

b. What would happen if EBIT were $3 million? $4 million? $8 million?

c. What would happen under the original conditions if the tax rate were 46 percent? If the interest rate on new debt were 8 percent and the preferred stock dividend rate were 7 percent? If the common could be sold for $40 per share?

8. Boehm-Gau Real Estate Speculators, Inc., and the Northern California Electric Utility Company have the following EBIT and debt-servicing burden:

<table>
<thead>
<tr>
<th></th>
<th>BOEHM-GAU</th>
<th>NORTHERN CALIFORNIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected EBIT</td>
<td>$5,000,000</td>
<td>$100,000,000</td>
</tr>
<tr>
<td>Annual interest</td>
<td>$1,600,000</td>
<td>$45,000,000</td>
</tr>
<tr>
<td>Annual principal payments on debt</td>
<td>$2,000,000</td>
<td>$35,000,000</td>
</tr>
</tbody>
</table>
Part 6 The Cost of Capital, Capital Structure, and Dividend Policy

The tax rate for Boehm-Gau is 40 percent, and for Northern California Electric Utility is 36 percent. Compute the interest coverage and the debt-service coverage ratios for the two companies. With which company would you feel more comfortable if you were a lender? Why?

9. The debt ratios of four companies are

<table>
<thead>
<tr>
<th>COMPANY</th>
<th>TOTAL DEBT/ TOTAL ASSETS</th>
<th>LONG-TERM DEBT/ TOTAL CAPITALIZATION*</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.56</td>
<td>0.43</td>
</tr>
<tr>
<td>B</td>
<td>0.64</td>
<td>0.66</td>
</tr>
<tr>
<td>C</td>
<td>0.47</td>
<td>0.08</td>
</tr>
<tr>
<td>D</td>
<td>0.42</td>
<td>0.26</td>
</tr>
</tbody>
</table>

*Total capitalization represents all long-term debt plus shareholders’ equity.

The companies are part of the following industries: supermarket, chemical, apparel making, and airline (not in order). Match the company with the industry.

Solutions to Self-Correction Problems

1. a. \( Q_{BE} = \frac{3M}{(2.00 - 1.75)} = 12 \text{ million half pints} \)

\[ S_{BE} = \frac{3M}{1 - (1.75/2.00)} = 24 \text{ million in annual sales} \]

b. \( Q_{BE} = \frac{3M}{(2.00 - 1.68)} = 9.375 \text{ million half pints} \)

c. \( Q_{BE} = \frac{3.75M}{(2.00 - 1.75)} = 15 \text{ million half pints} \)

d. \( DOL_{16 \text{ million units}} = \frac{16M}{(16M - 12M)} = 4 \)

e. (15 percent) \times 4 = 60\% \text{ increase in EBIT} \)

2. a. \( (\text{Percentage change in sales}) \times DOL = \text{Percentage change in EBIT} \)

(20 percent) \times 2 = 40\% \text{ change in EBIT} \)

Therefore, $1,000 \times (1 + 0.40) = $1,400

b. \( DOL_{10,000 \text{ units}} = \frac{10,000}{10,000 - Q_{BE}} = 2 \)

Therefore \( Q_{BE} \) must equal 5,000 units.

\( DOL_{12,000 \text{ units}} = \frac{12,000}{12,000 - 5,000} = 1.7 \)

3. a. (000s omitted)

<table>
<thead>
<tr>
<th></th>
<th>DEBT</th>
<th>PREFERRED STOCK</th>
<th>COMMON STOCK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating profit (EBIT)</td>
<td>$1,500</td>
<td>$1,500</td>
<td>$1,500</td>
</tr>
<tr>
<td>Interest on existing debt</td>
<td>360</td>
<td>360</td>
<td>360</td>
</tr>
<tr>
<td>Interest on new debt</td>
<td>$560</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Profit before taxes</td>
<td>$580</td>
<td>$1,140</td>
<td>$1,140</td>
</tr>
<tr>
<td>Taxes</td>
<td>$323</td>
<td>456</td>
<td>456</td>
</tr>
<tr>
<td>Profit after taxes</td>
<td>$348</td>
<td>$684</td>
<td>$684</td>
</tr>
<tr>
<td>Preferred stock dividend</td>
<td>–</td>
<td>480</td>
<td>–</td>
</tr>
<tr>
<td>Earnings available to common shareholders</td>
<td>$348</td>
<td>$204</td>
<td>$684</td>
</tr>
<tr>
<td>Number of shares</td>
<td>800</td>
<td>800</td>
<td>1,050</td>
</tr>
<tr>
<td>Earnings per share</td>
<td>$0.435</td>
<td>$0.235</td>
<td>$0.651</td>
</tr>
</tbody>
</table>
Approximate indifference points:

Debt (1) and common (3): **$2.7 million in EBIT**
Preferred (2) and common (3): **$3.7 million in EBIT**

Debt dominates preferred by the same margin throughout. There is no indifference point between these two alternative financing methods.

Mathematically, the indifference point between debt (1) and common (3), with 000s omitted, is

\[
\frac{(EBIT_{1,3} - $920)(1 - 0.40) - 0}{800} = \frac{(EBIT_{1,3} - $360)(1 - 0.40) - 0}{1,050}
\]

Cross multiplying and rearranging, we obtain

\[
(EBIT_{1,3})(0.60)(1,050) - (920)(0.60)(1,050) = (EBIT_{1,3})(0.60)(800) - (360)(0.60)(800)
\]

\[
(EBIT_{1,3})(1,050) - (579,600) = (EBIT_{1,3})(480) - (172,800)
\]

\[
(EBIT_{1,3})(150) = 406,800
\]

\[
EBIT_{1,3} = \frac{2,712}{1000}
\]

Note that, for the debt alternative, the total before-tax interest is $920, and this is the intercept on the horizontal axis. For the preferred stock alternative, we divide $480 by (1 - 0.4) to get $800. When this is added to $360 in interest on existing debt, the intercept becomes $1,160.

c. Debt (1):

\[
DFL_{EBIT \text{ of } $1.5 \text{ million}} = \frac{1,500,000}{1,500,000 - 920,000} = 2.59
\]

Preferred (2):

\[
DFL_{EBIT \text{ of } $1.5 \text{ million}} = \frac{1,500,000}{1,500,000 - 360,000 - [480,000/(1 - 0.40)]} = 4.41
\]
Common (3):

\[ DFL_{\text{EBIT of } $1.5 \text{ million} = \frac{1,500,000}{1,500,000 - 360,000} = 1.32} \]

d. For the present EBIT level, common is clearly preferable. EBIT would need to increase by \(2,712,000 - 1,500,000 = 1,212,000\) before an indifference point with debt is reached. One would want to be comfortably above this indifference point before a strong case for debt should be made. The lower the probability that actual EBIT will fall below the indifference point, the stronger the case that can be made for debt, all other things the same.

4. Percentage change in operating profit (EBIT) \(= \frac{\Delta Q(P - V)}{Q(P - V - FC)}\)
which reduces to \(DOL_{\text{units}} = \frac{Q(P - V)}{Q(P - V - FC)}\)

Dividing both the numerator and denominator by \((P - V)\) produces

\[ DOL_{\text{units}} = \frac{Q}{Q - (FC/\bar{Q} - V)} = \frac{Q}{Q - Q_{\text{BE}}} \]

5. a. Total annual interest is determined as follows:

\[
\begin{align*}
15\% \text{ of } $2.4 \text{ million} &= $360,000 \\
13\% \text{ of } $3.0 \text{ million} &= 390,000 \\
18\% \text{ of } $2.0 \text{ million} &= 360,000 \\
\text{Interest coverage ratio} &= $2,000,000/$1,110,000 = 1.80 \\
\text{Total annual principal payments} &= $100,000 + $150,000 = $250,000 \\
\text{Debt-service coverage ratio} &= \frac{2,000,000}{1,110,000 + \frac{[250,000/(1 - 0.50)]}{\text{units}}} = 1.24 \\
\end{align*}
\]

b. Required deviation of EBIT from its mean value before ratio in question becomes 1:1:

\[
\begin{align*}
\text{Interest coverage: } $1,110,000 - $2,000,000 &= -$890,000 \\
\text{Debt-service coverage: } $1,610,000 - $2,000,000 &= -$390,000 \\
\end{align*}
\]

Standardizing each deviation from the mean produces the following Z-scores:

\[
\begin{align*}
\text{Interest coverage: } -$890,000 \quad \frac{-890,000}{1,500,000} &= -0.593 \text{ standard deviations (left of the mean)} \\
\text{Debt-service coverage: } -$390,000 \quad \frac{-390,000}{1,500,000} &= -0.260 \text{ standard deviations (left of the mean)} \\
\end{align*}
\]

Table V in the Appendix at the end of the book can be used to determine the proportion of the area under the normal curve that is Z standard deviations left of the mean. This proportion corresponds to the probability that an EBIT figure will occur that produces coverage ratios lower than 1:1. For interest coverage and debt-service coverage ratios less than 1:1, these probabilities are approximately 28 percent and 40 percent, respectively. These probabilities assume that the distribution of possible EBITs is normal.

c. There is a substantial probability, 40 percent, that the company will fail to cover its interest and principal payments. Its debt ratio (using either book or market values) is much higher than the industry norm of 0.47. Although the information is limited,
based on what we have, it would appear that Archimedes has too much debt. However, other factors, such as liquidity, may mitigate this conclusion.

6. Aberez has a lower debt ratio than its industry norm. Vorlas has a higher ratio relative to its industry. Both companies exceed modestly their industry norms with respect to interest coverage. The lower debt-to-equity ratio and higher interest coverage for Vorlas’s industry suggests that its industry might have more business risk than the industry of which Aberez is a part. The liquidity ratio of Aberez is higher than the industry norm, whereas that for Vorlas is lower than the industry norm. Although all three financial ratios for Vorlas are better than those for Aberez, they are lower relative to the industry norm. Finally, the bond rating of Aberez is much better than that of Vorlas, being an Aa grade and higher than the industry norm. The bond rating of Vorlas is one grade below the very lowest grade for investment-grade bonds. It is also lower than the typical company’s bond rating in the industry. If the industry norms are reasonable representations of underlying business and financial risk, we would say that Vorlas had the greater degree of risk.

Selected References

Part VI of the text’s website, Wachowicz’s Web World, contains links to many finance websites and online articles related to topics covered in this chapter. (http://web.utk.edu/~jwachowi/part6.html)