# Risk, Cost of Capital, and Capital Budgeting

## OPENING CASE

With over 95,000 employees on five continents, Germany-based BASF is a major international company. It operates in a variety of industries, including agriculture, oil and gas, chemicals, and plastics. In an attempt to increase value, BASF launched BASF 2015, a comprehensive plan that included all functions within the company and challenged and encouraged all employees to act in an entrepreneurial manner. The major financial component of the strategy was that the company expected to earn its weighted average cost of capital, or WACC, plus a premium. So, what exactly is the WACC?

The WACC is the minimum return a company needs to earn to satisfy all of its investors, including stockholders, bondholders, and preferred stockholders. In 2010, for example, BASF pegged its WACC at 9 percent, the same number it had used in 2009. This was in contrast to 2008 when the company had estimated its WACC at 10 percent. In this chapter, we learn how to compute a firm's cost of capital and find out what it means to the firm and its investors. We will also learn when to use the firm's cost of capital, and, perhaps more important, when not to use it.

The goal of this chapter is to determine the rate at which cash flows of risky projects are to be discounted. Projects are financed with equity, debt, and other sources, and we must estimate the cost of each of these sources in order to determine the appropriate discount rate. We begin with the cost of equity capital. Since the analysis here builds on beta and the capital asset pricing model (CAPM), we discuss beta in depth, including its calculation, its intuition, and its determinants. We next discuss the cost of debt and the cost of preferred stock. These costs serve as building blocks for the weighted average cost of capital (WACC), which is used to discount cash flows. We calculate the WACC for a real-world company, Eastman Chemical Co. Finally, we introduce flotation costs.

## 12.1 THE COST OF EQUITY CAPITAL

Whenever a firm has extra cash, it can take one of two actions. It can pay out the cash immediately as a dividend. Alternatively, the firm can invest the extra cash in a project, paying out the future cash flows of the project as dividends. Which action would the

**FIGURE 12.1**

Choices of a Firm with
Extra Cash

**Corporation receives cash.
It can either:**

**Pay dividend**

Invest cash in project

Shareholder invests
dividend in financial asset

**Stockholders want the firm to invest in a project only if the
expected return on the project is at least as great as that of
a financial asset of comparable risk.**
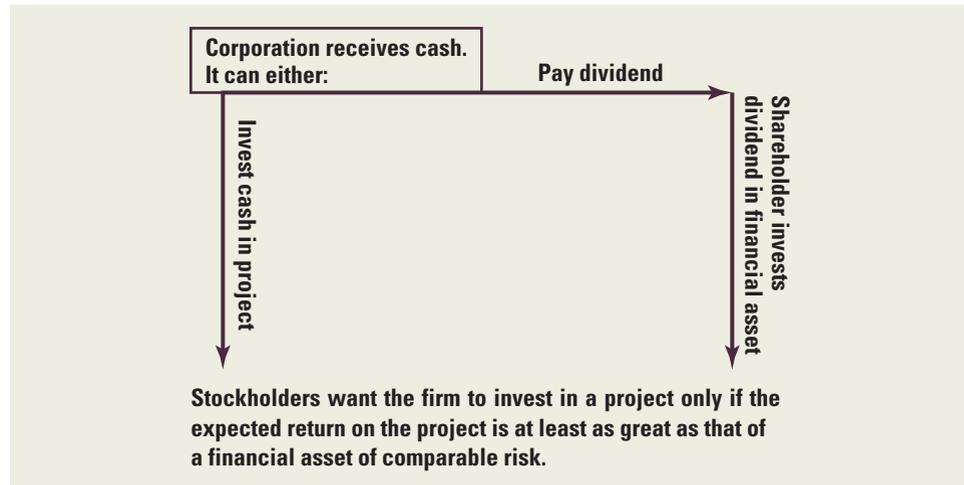
stockholders prefer? If a stockholder can reinvest the dividend in a financial asset (a stock or bond) with the same risk as that of the project, the stockholders would desire the alternative with the highest expected return. In other words, the project should be undertaken only if its expected return is greater than that of a financial asset of comparable risk. This idea is illustrated in Figure 12.1. Our discussion implies a very simple capital budgeting rule:

**The discount rate of a project should be the expected return on a financial asset of comparable risk.**

There are various synonyms for the discount rate. For example, the discount rate is often called the *required return* on the project. This is an appropriate name, since the project should be accepted only if the project generates a return above what is required. Alternatively, the discount rate of the project is said to be its *cost of capital*. This name is also appropriate, since the project must earn enough to pay its suppliers of capital, in this case the stockholders. Our book will use these three terms, the discount rate, the required return, and the cost of capital, synonymously.

Now imagine that all projects of the firm have the same risk. In that case, one could say that the discount rate is equal to the cost of capital for the firm as a whole. And, if the firm is all equity, the discount rate is also equal to the firm's cost of equity capital.

## 12.2 ESTIMATING THE COST OF EQUITY CAPITAL WITH THE CAPM

It's one thing to define the cost of equity capital, as we have done above. It's quite another to estimate it. The problem is that stockholders do not tell the firm what their required returns are. So, what do we do? Luckily, the capital asset pricing model (CAPM) can be used to estimate the required return.

Under the CAPM, the expected return on the stock can be written as:

$$R_S = R_F + \beta \times (R_M - R_F) \tag{12.1}$$

where $R_F$ is the risk-free rate and $R_M - R_F$ is the difference between the expected return on the market portfolio and the riskless rate. This difference is often called the expected *excess*

market return or market risk premium. Note we have dropped the bar denoting expectations from our expression to simplify the notation, but remember that we are always thinking about *expected* returns with the CAPM.

The expected return on the stock in Equation 12.1 is based on the stock's risk, as measured by beta. Alternatively, we could say that this expected return is the required return on the stock, based on the stock's risk. Similarly, this expected return can be viewed as the firm's cost of equity capital.

It is important to stress the symmetry between the expected return to the shareholder and the cost of capital to the firm. Imagine a company issuing new equity to fund a capital budgeting project. The new shareholder's return comes in the form of dividends and capital gains. These dividends and capital gains represent costs to the firm. It is easier to see this for dividends. Any dividend paid to a new shareholder is cash that cannot be paid to an old shareholder. But capital gains also represent a cost to the firm. Appreciation in the value of a firm's stock is shared by all stockholders. If part of the capital gain goes to new stockholders, only the remainder can be captured by the old stockholders. In other words, the new shareholders dilute the capital gain of the old shareholders. More will be said on this important point a little later.

While academics have long argued for the use of the CAPM in capital budgeting, how prevalent is this approach in practice? One study[1] finds that almost three-fourths of U.S. companies use the CAPM in capital budgeting, indicating that industry has largely adopted the approach of this, and many other, textbooks. This fraction is likely to increase, since so many of the undergraduates and MBAs who were taught the CAPM in school are now reaching positions of power in corporations.

We now have the tools to estimate a firm's cost of equity capital. To do this, we need to know three things:

- The risk-free rate, $R_F$.
- The market risk premium, $R_M - R_F$.
- The stock beta, $\beta$.

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**EXAMPLE 12.1**

**Cost of Equity**

Suppose the stock of the Quatram Company, a publisher of college textbooks, has a beta ($\beta$) of 1.3. The firm is 100 percent equity financed; that is, it has no debt. Quatram is considering a number of capital budgeting projects that will double its size. Because these new projects are similar to the firm's existing ones, the average beta on the new projects is assumed to be equal to Quatram's existing beta. The risk-free rate is 5 percent. What is the appropriate discount rate for these new projects, assuming a market risk premium of 8.4 percent?

We estimate the cost of equity, $R_S$, for Quatram as:

$$R_S = 5\% + (8.4\% \times 1.3)$$
$$= 5\% + 10.92\%$$
$$= 15.92\%$$

Two key assumptions were made in this example: (1) The beta risk of the new projects is the same as the risk of the firm, and (2) the firm is all equity financed. Given these assumptions, it follows that the cash flows of the new projects should be discounted at the 15.92 percent rate.

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[1]John R. Graham and Campbell R. Harvey, "The Theory and Practice of Corporate Finance: Evidence from the Field," *Journal of Financial Economics* (2001), report in their Table 3 that 73.49 percent of the companies in their sample use the CAPM for capital budgeting.

EXAMPLE 12.2

## Project Evaluation and Beta

Suppose Alpha Air Freight is an all-equity firm with a beta of 1.21. Further suppose the market risk premium is 9.5 percent, and the risk-free rate is 5 percent. We can determine the expected return on the common stock of Alpha Air Freight from Equation 12.1. We find that the expected return is:

$$5\% + (1.21 \times 9.5\%) = 16.495\%$$

Because this is the return that shareholders can expect in the financial markets on a stock with a β of 1.21, it is the return they expect on Alpha Air Freight's stock.

Further suppose Alpha is evaluating the following non–mutually exclusive projects:

| PROJECT | PROJECT'S BETA (β) | PROJECT'S EXPECTED CASH FLOWS NEXT YEAR | PROJECT'S INTERNAL RATE OF RETURN | PROJECT'S NPV WHEN CASH FLOWS ARE DISCOUNTED AT 16.495% | ACCEPT OR REJECT |
|---|---|---|---|---|---|
| A | 1.21 | $140 | 40% | $20.2 | Accept |
| B | 1.21 | 120 | 20 | 3.0 | Accept |
| C | 1.21 | 110 | 10 | −5.6 | Reject |

Each project initially costs $100. All projects are assumed to have the same risk as the firm as a whole. Because the cost of equity capital is 16.495 percent, projects in an all-equity firm are discounted at this rate. Projects A and B have positive NPVs, and C has a negative NPV. Thus, only A and B will be accepted. This result is illustrated in Figure 12.2.

### FIGURE 12.2

Using the Security Market Line to Estimate the Risk-Adjusted Discount Rate for Risky Projects



The diagonal line represents the relationship between the cost of equity capital and the firm's beta. An all-equity firm should accept a project whose internal rate of return is greater than the cost of equity capital, and should reject a project whose internal rate of return is less than the cost of equity capital. (This graph assumes that all projects are as risky as the firm.)

In the previous two examples, the values for the risk-free rate, the market risk premium, and the firm's beta were *assumed*. How would we go about estimating these parameters in practice? We will investigate each of these parameters in turn.

## The Risk-Free Rate

While no bond is completely free of the risk of default, Treasury bills and bonds in the United States are about as close to this ideal as possible. No U.S. Treasury instrument has ever defaulted and, at least at the present time, no instrument is considered to be in the slightest danger of a future default. For this reason, Treasury instruments are generally considered to be risk-free.

However, as we learned from Chapter 8, there is a whole term structure of interest rates, where the yield on any Treasury instrument is a function of that instrument's maturity. Which maturity should have its yield serve as the risk-free rate? The CAPM is a period-by-period model, so a good case can be made that a short-term rate should be chosen. The one-year Treasury bill rate is used very frequently and we will adopt this convention.[2]

## Market Risk Premium

**METHOD 1: USING HISTORICAL DATA** Much of Chapter 10 was devoted to the calculation of historical rates of return and the market risk premium. The chapter settled on an estimate of 7 percent for the premium, though this number should not be interpreted as definitive. Next we need a risk-free rate. The current one-year Treasury bill is about .75 percent.

As a quick example, consider an all-equity company with a beta of 1.5. Given our parameters, its cost of capital would be:

$$.75\% + 1.5 \times 7\% = 11.25\%$$

**METHOD 2: USING THE DIVIDEND DISCOUNT MODEL (DDM)** Earlier in this chapter, we referenced a study indicating that most corporations use the CAPM for capital budgeting. Does the CAPM imply that risk premiums must be calculated from past returns, as we did above? The answer is no. There is another method, based on the dividend discount model of an earlier chapter, for estimating the risk premium.

In Chapter 6, we pointed out that the price of a share of stock is equal to the present value of all of its future dividends. Furthermore, we noted in that chapter that, if the firm's dividends are expected to grow at a constant rate, $g$, the price of a share of stock, $P$, can be written as:

$$P = \frac{Div}{R - g}$$

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[2]The problem is that projects typically have long lives, so the average one-year rate anticipated over the life of the project, rather than today's one-year rate, is potentially more accurate.

How can we estimate this expected one-year rate? We can use the current one-year Treasury bill rate and assume it will be the same over the life of the project. This is our convention. On the other hand, the anticipated average one-year rate can be estimated from the term structure. Table 10.2 shows that, over the period from 1926 to 2009, the average return on 20-year bonds was 5.8 percent, and the average return on one-year Treasury bills was 3.7 percent. Thus, the term premium, as it is called, was 5.8 − 3.7 = 2.1%. This positive term premium is not surprising, since we know that the term structure of interest rates typically slopes upward. As of one recent date, the yield on a 10-year Treasury bond was about 3.5 percent. This yield should reflect both the average one-year interest rate over the next 10 years and the term premium. Thus, one can argue that the average one-year interest rate expected over the next 10 years is 3.5% − 2.1% = 1.4%. Alternatively, the CAPM suggests we should use a Treasury security whose maturity matches the investment horizon of investors. Unfortunately, no one agrees on what horizon that is.

where Div is the dividend per share to be received next year, $R$ is the discount rate, and $g$ is the constant annual rate of growth in dividends. This equation can be rearranged, yielding:

$$R = \frac{Div}{P} + g$$

In words, the annual return on a stock is the sum of the dividend yield ($=Div/P$) over the next year plus the annual growth rate in dividends.

Just as this formula can be used to estimate the total return on a stock, it can be used to estimate the total return on the market as a whole. The first term on the right-hand side is easy to estimate, since a number of print and Internet services calculate the dividend yield for the market. For example, *The Wall Street Journal* recently stated that the average dividend yield across all stocks in the Standard & Poor's (S&P) 500 Index was about 3.1 percent. We will use this number in our forecasts.

Next, we need an estimate of the per-share growth rate in dividends across all companies in the market. Security analysts, who are typically employees of investment banking houses, money management firms, and independent research organizations, study individual securities, industries, and the overall stock market. As part of their work, they forecast dividends and earnings, as well as make stock recommendations. For example, suppose the numbers in the *Value Line (VL) Investment Survey* imply a five-year growth rate in dividends for VL's Industrial Composite Index of about 6 percent per year. With a dividend yield of 3.1 percent, the expected return on the market becomes $3.1\% + 6\% = 9.1\%$. Given our one-year yield on Treasury bills of .75 percent, the market risk premium would be $9.1\% - .75\% = 8.35\%$, a number somewhat above the 7 percent provided by method 1.

For our firm with a beta of 1.5, the cost of capital becomes:

$$.75\% + 1.5 \times 8.35\% + 13.28\%$$

Of course, Value Line is just one source for forecasts. More likely, a firm would either rely on a consensus of many forecasts or use its own subjective growth estimate. While the market risk premium we provided based on Value Line's forecasts is above our historical premium of 7 percent, academics using the DDM approach generally come in with a risk premium below, and in some cases significantly below, the historical risk premium.

Academics have, nevertheless, long preferred the historical market risk premium for its objectivity. Since historical returns have been precisely measured, there is little room for subjective judgment. By contrast, estimation of future dividend growth in the DDM is more subjective. However, the subjective nature of the DDM approach is not meant as a criticism. A number of financial economists[3] have made cogent arguments in defense of the DDM, and this approach is gaining traction in academia. In particular, these academic proponents point out that returns in the long run can only come from the current dividend yield and future dividend growth. Anyone who thinks that long-run stock returns will exceed the sum of these two components is fooling himself. The expression, "You can't squeeze blood out of a turnip," applies here.

## 12.3 ESTIMATION OF BETA

In the previous section, we assumed that the beta of the company was known. Of course, beta must be estimated in the real world. We pointed out earlier that the beta of a security is the standardized covariance of a security's return with the return on the market portfolio. As we have seen, the formula for security $i$ is:

$$\text{Beta of security } i = \frac{\text{Cov}(R_i, R_M)}{\text{Var}(R_M)} = \frac{\sigma_{i,M}}{\sigma_M^2} \qquad [12.2]$$

[3]For example, see Jay Ritter, "The Biggest Mistakes We Teach," *Journal of Financial Research* (Summer 2002); Eugene Fama and Kenneth French, "The Equity Premium," *Journal of Finance* (2002); and R. Jagannathan, E. R. McGrattan, and A. Scherbina, "The Declining U.S. Equity Premium," *Federal Reserve Bank of Minneapolis Quarterly Review* (2000).

In words, the beta is the covariance of a security with the market, divided by the variance of the market. Because we calculated both covariance and variance in earlier chapters, calculating beta involves no new material.

## Measuring Company Betas

The basic method of measuring company betas is to estimate:

$$\frac{\text{Cov}(R_i, R_M)}{\text{Var}(R_M)}$$

using $t = 1, 2, \ldots, T$ observations.

### Problems

1. Betas may vary over time.
2. The sample size may be inadequate.
3. Betas are influenced by changing financial leverage and business risk.

### Solutions

1. Problems 1 and 2 can be moderated by more sophisticated statistical techniques.
2. Problem 3 can be lessened by adjusting for changes in business and financial risk.
3. Look at average beta estimates of several comparable firms in the industry.

### Real-World Betas

It is instructive to see how betas are determined for actual real-world companies. Figure 12.3 plots monthly returns for four large firms against monthly returns on the Standard & Poor's (S&P) 500 Index. Using a standard regression technique, we fit a straight line through data points. The result is called the "characteristic" line for the security. The slope of the characteristic line is beta. Though we have not shown it in the figure, we can also determine the intercept (commonly called alpha) of the characteristic line by regression.

We use five years of monthly data for each plot. Although this choice is arbitrary, it is in line with calculations performed in the real world. Practitioners know that the accuracy of the beta coefficient is suspect when too few observations are used. Conversely, because firms may change their industry over time, observations from the distant past are out of date.

We stated in a previous chapter that the average beta across all stocks in an index is 1. Of course, this need not be true for a subset of the index. For example, of the four securities in Figure 12.3, two have betas above 1 and two have betas below 1. Because beta is a measure of the risk of a single security for someone holding a large, diversified portfolio, our results indicate that Microsoft has relatively low risk and Amazon.com has relatively high risk.

### Stability of Beta

We have stated that the beta of a firm is likely to change if the firm changes its industry. It is also interesting to ask the reverse question: Does the beta of a firm stay the same if its industry stays the same?

Take the case of American Airlines, now called AMR Corporation, which has remained in the same industry for many decades. Figure 12.4 plots the returns on AMR and the returns on the S&P 500 for four successive five-year periods. As can be seen from the figure, AMR's beta varies from period to period. However, this movement in beta is probably

**FIGURE 12.3**

Plots of Five Years of
Monthly Returns (2003–
2007) on Four Individual
Securities against Five
Years of Monthly Returns
on the Standard & Poor's
(S&P) 500 Index
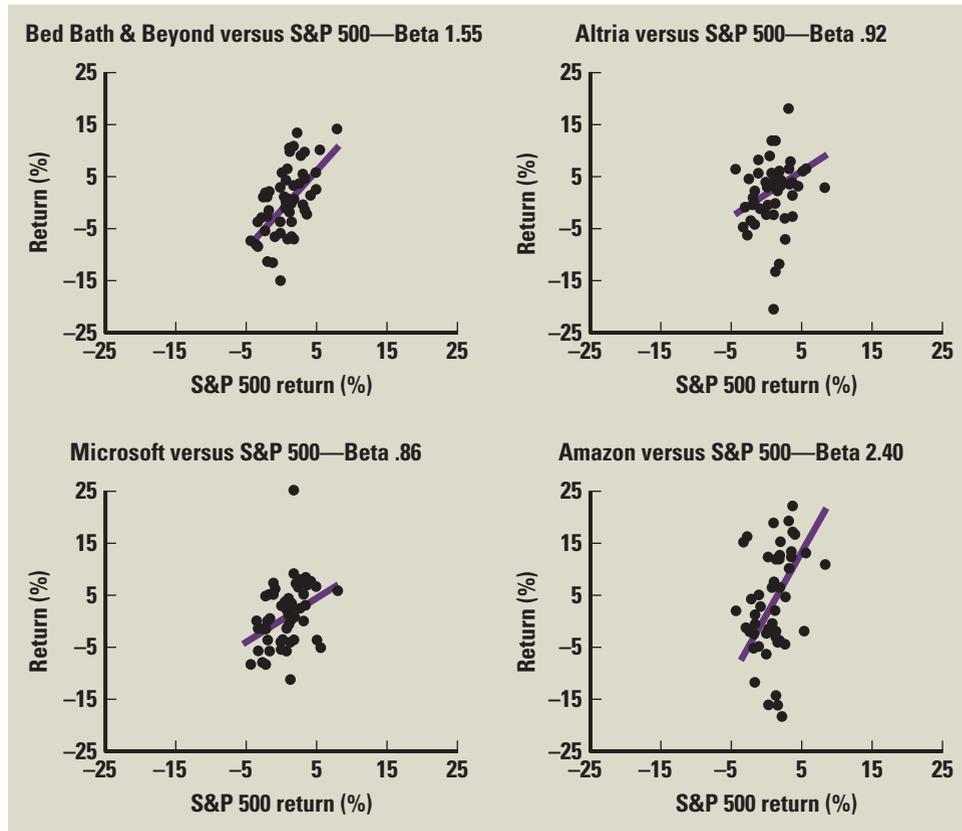


nothing more than random variation.[4] Thus, for practical purposes, AMR's beta has been approximately constant over the two decades covered in Figure 12.4. Although AMR is just one company, most analysts argue that betas are generally stable for firms remaining in the same industry.

However, this is not to say that, as long as a firm stays in the same industry, its beta will *never* change. Changes in product line, changes in technology, or changes in the market may affect a firm's beta. Furthermore, as we will show in a later section, an increase in the leverage of a firm (i.e., the amount of debt in its capital structure) will increase the firm's beta.

## Using an Industry Beta

Our approach to estimating the beta of a company from its own past data may seem to have common sense. However, it is frequently argued that people can better estimate a firm's beta by involving the whole industry. Consider Table 12.1, which shows the betas of some prominent firms in the software industry. The average beta across all of the firms in the table is 1.27. Imagine a financial executive at Symantec trying to estimate the firm's beta. Because beta estimation is subject to large, random variation in this volatile industry, the executive may be uncomfortable with the estimate of .64. However, the error in beta estimation on a single stock is much higher than the error for a portfolio of securities. Thus, the executive of Symantec may prefer the average industry beta of 1.27 as the estimate of its own firm's beta.[5]

[4]More precisely, we can say that the beta coefficients over the four periods are not statistically different from each other.

[5]Actually, one should adjust for leverage before averaging betas, though not much is gained unless leverage ratios differ significantly. Adjustment for leverage will be discussed in later chapters.
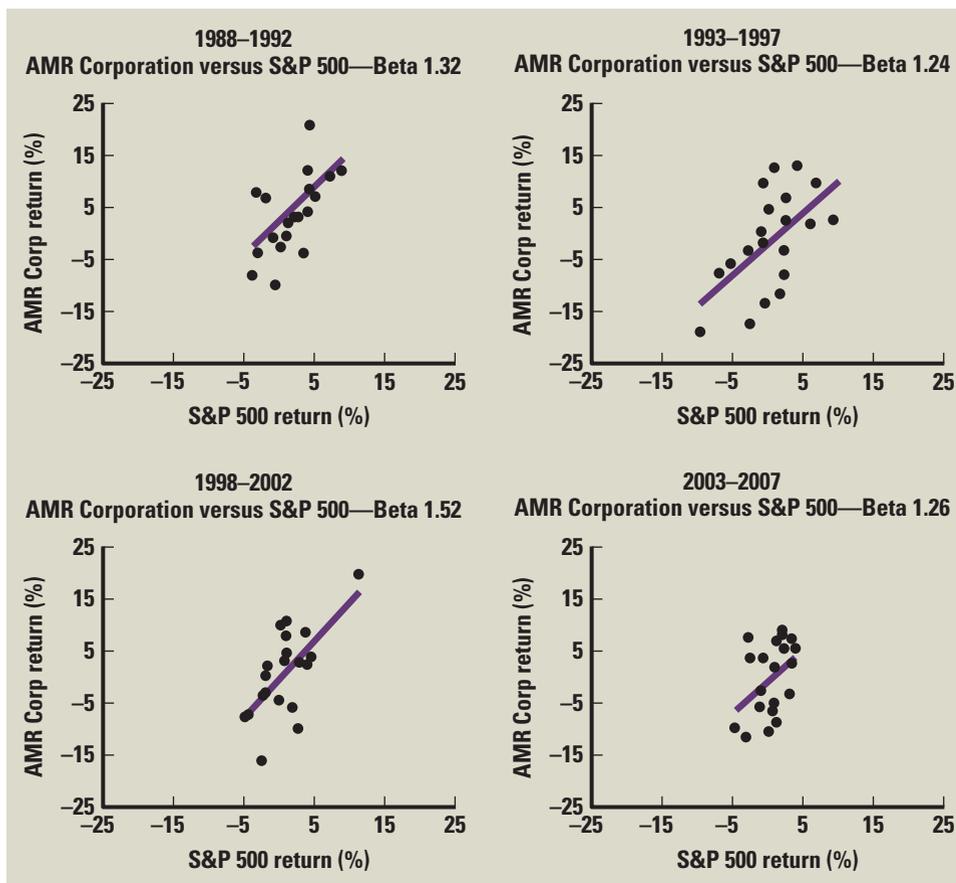
**FIGURE 12.4**

Plots of Monthly Returns on AMR Corporation against Returns on the Standard & Poor's 500 Index for Four Consecutive Five-Year Periods

Assuming a risk-free rate of .75 percent and a risk premium of 7 percent, Symantec might estimate its cost of equity capital as:

**.75% + .64 × 7% = 5.23%**

However, if Symantec believed the industry beta contained less estimation error, it could estimate its cost of equity capital as:

**.75% + 1.27 × 7% = 9.64%**

| COMPANY | BETA |
| --- | --- |
| Microsoft | .86 |
| Apple, Inc. | 2.43 |
| Automatic Data Processing | .76 |
| Electronic Data Systems | 1.13 |
| Oracle Corp. | 1.54 |
| Computer Sciences | 1.19 |
| CA, Inc. | 2.03 |
| Fiserv, Inc. | 1.24 |
| Accenture, Ltd. | 1.18 |
| Symantec Corp. | .64 |
| Paychex, Inc. | .96 |
| Equally weighted portfolio | 1.27 |

**TABLE 12.1**

Betas for Firms in the Computer Software Industry

The difference is substantial here, presenting a difficult choice for a financial executive at Symantec.

While there is no formula for selecting the right beta, there is a very simple guideline. If you believe that the operations of a firm are similar to the operations of the rest of the industry, you should use the industry beta simply to reduce estimation error.[6] However, if an executive believes that the operations of the firm are fundamentally different from those in the rest of the industry, the firm's beta should be used.

When we discussed financial statement analysis in Chapter 3, we noted that a problem frequently comes up in practice—namely, what is the industry? For example, Value Line's *Investment Survey* categorizes Accenture, Ltd., as a computer software company, whereas online financial providers such as www.reuters.com/finance categorize the same company in the business services industry.

## 12.4 BETA AND COVARIANCE

Now that you know how to calculate beta, we want to give you a deeper understanding of what beta is. Since beta is a statistic, it is worthwhile to compare beta to other statistics. We begin this section by comparing beta to covariance.

### Beta and Covariance

Consider the following thought experiment. Imagine that, using past data over the last five years and the techniques of the previous section, you estimate beta for each of the 30 securities in the Dow Jones Industrial Index. You then rank these 30 securities from highest to lowest beta. Next, imagine that your friend does the same exercise for covariance. That is, using the same data over the last five years, he estimates the covariance of each of the 30 securities and ranks them from high to low.

How will your ranking on beta and your friend's ranking on covariance be related? You may be surprised to find that the two rankings are *identical*. Here's why. Consider Formula 12.2, relating beta to covariance, which we reproduce below:

$$\text{Beta of security } i = \frac{\text{Cov}(R_i, R_M)}{\text{Var}(R_M)}$$

where $\text{Cov}(R_i, R_M)$ is the covariance between the return on asset $i$ and the return on the market portfolio, and $\text{Var}(R_M)$ is the variance of the return on the market. The formula tells us that we go from covariance to beta by dividing by a constant, the variance of the market. Rankings are always preserved when we divide by a constant. For example, suppose we rank everyone in your finance class by height, as measured in inches. A basketball player might be the tallest at, say, 84 inches. Now we convert everyone's height to feet by dividing by 12. The basketball player would come in at $84/12 = 7$ feet and still be tallest. The same principle applies to the above formula for beta. For every stock, the variance of the market is the denominator of the beta calculation. Thus, a stock with a high covariance relative to other stocks must have a high beta relative to other stocks and vice versa. This is an important point because it tells us that beta and covariance, while they are two different statistical terms, measure the same concept.

What is that concept? As stated in Chapter 11, beta measures the responsiveness of the return on the security to the return on the market. For example, Figure 12.3 tells us that Microsoft's beta is .86. A 1 percent return on the market would imply an expected return on the security of .86 percent. Because beta is just a transformation of covariance, covariance must measure responsiveness as well.

Which term, beta or covariance, is easier to use? Beta is clearly easier to use because of the above interpretation. Covariance, while it also measures responsiveness, does not lead

[6]As we will see later, an adjustment must be made when the debt level in the industry is different from that of the firm. However, we ignore this adjustment here because firms in the software industry generally have little debt.

to the same interpretation. If, for example, the covariance between a security and the market is, say, .0056, we *cannot* state that the stock is expected to rise .0056 percent for every 1 percent return on the market portfolio. In fact, the covariance number does not lend itself to any easy interpretation. We are better off thinking in terms of beta. For example, when Wall Street firms train new hires in modern portfolio theory, they often teach both beta and covariance but then tell the recruits, "Never use the word, covariance, again. Anything you can say in terms of covariance, you can say more clearly in terms of beta." While this injunction may be going too far for our tastes, we agree with the sentiment.

## 12.5 DETERMINANTS OF BETA

The regression analysis approach in Section 12.3 doesn't tell us where beta comes from. Of course, the beta of a stock does not come out of thin air. Rather, it is determined by the characteristics of the firm. We consider three factors: The cyclical nature of revenues, operating leverage, and financial leverage.

### Cyclicality of Revenues

The revenues of some firms are quite cyclical. That is, these firms do well in the expansion phase of the business cycle and do poorly in the contraction phase. Empirical evidence suggests high-tech firms, retailers, and automotive firms fluctuate with the business cycle. Firms in industries such as utilities, railroads, food, and airlines are less dependent on the cycle. Because beta measures the responsiveness of a stock's return to the market's return, it is not surprising that highly cyclical stocks have high betas.

It is worthwhile to point out that cyclicality is not the same as variability. For example, a moviemaking firm has highly variable revenues because hits and flops are not easily predicted. However, because the revenues of a studio are more dependent on the quality of its releases than the phase of the business cycle, motion picture companies are not particularly cyclical. In other words, stocks with high standard deviations need not have high betas, a point we have stressed before.

### Operating Leverage

We distinguished fixed costs from variable costs in Chapter 9. At that time, we mentioned that fixed costs do not change as quantity changes. Conversely, variable costs increase as the quantity of output rises. Firms often face a trade-off between fixed and variable costs. For example, a firm can build its own factory, incurring a high level of fixed costs in the process. Alternatively, the firm can outsource production to a supplier, typically generating lower fixed costs but higher variable costs. Fixed costs tend to magnify the impact of sales cyclicality. Fixed costs must be paid, even at a low level of sales, leaving the firm with the possibility of large losses. And with fixed costs replacing variable costs, any additional sales generate low marginal costs, leaving the firm with a substantial increase in profit.

Firms with high fixed costs and low variable costs are generally said to have high **operating leverage**. Conversely, firms with low fixed and high variable costs have low operating leverage. Operating leverage magnifies the effect of the cyclicality of a firm's revenues on beta. That is, a firm with a given sales cyclicality will increase its beta if fixed costs replace variable costs in its production process.

### Financial Leverage and Beta

As suggested by their names, operating leverage and financial leverage are analogous concepts. Operating leverage refers to the firm's fixed costs of *production*. Financial leverage is the extent to which a firm relies on debt, and a levered firm is a firm with some debt in its capital structure. Because a *levered* firm must make interest payments regardless of the firm's sales, financial leverage refers to the firm's fixed costs of *finance*.

Just as an increase in operating leverage increases beta, an increase in financial leverage (i.e., an increase in debt) increases beta. To see this point, consider a firm with some debt and some equity in its capital structure. Further, imagine an individual who owns all the firm's debt and all its equity. In other words, this individual owns the entire firm. What is the beta of her portfolio of the firm's debt and equity?

As with any portfolio, the beta of this portfolio is a weighted average of the betas of the individual items in the portfolio. Let $B$ stand for the market value of the firm's debt and $S$ stand for the market value of the firm's equity. We have:

$$\beta_{\text{Portfolio}} = \beta_{\text{Asset}} = \frac{S}{B+S} \times \beta_{\text{Equity}} + \frac{B}{B+S} \times \beta_{\text{Debt}} \qquad \text{[12.3]}$$

where $\beta_{\text{Equity}}$ is the beta of the stock of the *levered* firm. Notice that the beta of debt, $\beta_{\text{Debt}}$, is multiplied by $B/(B+S)$, the percentage of debt in the capital structure. Similarly, the beta of equity is multiplied by the percentage of equity in the capital structure. Because the portfolio contains both the debt of the firm and the equity of the firm, the beta of the portfolio can be thought of as the beta of the common stock had the firm been all equity. In practice, this beta is called the **asset beta** because its value is dependent only on the assets of the firm.

The beta of debt is very low in practice. If we make the common assumption that the beta of debt is zero, we have:

$$\beta_{\text{Asset}} = \frac{S}{B+S} \times \beta_{\text{Equity}} \qquad \text{[12.4]}$$

Because $S/(B+S)$ must be below 1 for a levered firm, it follows that $\beta_{\text{Asset}} < \beta_{\text{Equity}}$. Rearranging this equation, we have:

$$\beta_{\text{Equity}} = \beta_{\text{Asset}}\left(1 + \frac{B}{S}\right)$$

The equity beta will always be greater than the asset beta with financial leverage (assuming the asset beta is positive).[7] In other words, the equity beta of a levered firm will always be greater than the equity beta of an otherwise identical all-equity firm.

Which beta does regression analysis estimate, the asset beta or the equity beta? Regression, as performed in Section 12.3 and also in the real world, provides us with an equity beta because the technique uses *stock* returns as inputs. We must transform this equity beta using Equation 12.4 to arrive at the asset beta. (Of course, the two betas are the same for an all-equity firm.)

**EXAMPLE 12.3**

**Asset versus Equity Betas**

Consider a tree growing company, Rapid Cedars, Inc., which is currently all equity and has a beta of .8. The firm has decided to move to a capital structure of one part debt to two parts equity. Because the firm is staying in the same industry, its asset beta should remain at .8. However, assuming a zero beta for its debt, its equity beta would become:

$$\beta_{\text{Equity}} = \beta_{\text{Asset}}\left(1 + \frac{B}{S}\right)$$
$$1.2 = .8\left(1 + \frac{1}{2}\right)$$

If the firm had one part debt to one part equity in its capital structure, its equity beta would be:

$$1.6 = .8(1 + 1)$$

However, as long as it stayed in the same industry, its asset beta would remain at .8. The effect of leverage, then, is to increase the equity beta.

[7]It can be shown that the relationship between a firm's asset beta and its equity beta with corporate taxes is

$$\beta_{\text{Equity}} = \beta_{\text{Asset}}\left[1 + (1 - t_c)\frac{B}{S}\right]$$

In this expression, $t_c$ is the corporate tax rate. Tax effects are considered in more detail in a later chapter.

## 12.6 DIVIDEND DISCOUNT MODEL

In Section 12.2, we showed how the CAPM could be used to determine a firm's cost of capital. Among other inputs, we needed an estimate of the market risk premium. One approach used the dividend discount model (DDM) to forecast the expected return on the market as a whole, leading to an estimate of this risk premium. We now use the DDM to estimate the expected return on an individual stock *directly*.

Our discussion in Section 12.2 on the DDM led to the following formula:

$$R = \frac{Div}{P} + g$$

where $P$ is the price per share of a stock, Div is the dividend per share to be received next year, $R$ is the discount rate, and $g$ is the constant annual growth rate in dividends per share. The equation tells us that the discount rate on a stock is equal to the sum of the stock's dividend yield ($=Div/P$) and its growth rate of dividends. Thus, in order to apply the DDM to a particular stock, we must estimate both the dividend yield and the growth rate.

The dividend yield is relatively easy to forecast. Security analysts routinely provide forecasts of next year's dividend for many stocks. Alternatively, we can set next year's dividend as the product of last year's dividend and $1 + g$, using approaches to estimate $g$ that we describe below. The price per share of any publicly traded stock can generally be determined from either financial newspapers or the Internet.

The growth rate of dividends can be estimated in one of three ways. First, we can calculate the firm's historical growth rate in dividends from past data. For some firms, this historical growth rate may be a serviceable, though clearly imperfect, estimate of the future growth rate. Second, in Chapter 6, we argued that the growth rate in dividends can be expressed as:

$$g = \text{Retention ratio} \times \text{ROE}$$

where the retention ratio is the ratio of retained earnings to earnings, and ROE stands for return on equity. Return on equity is the ratio of earnings to the last period's accounting book value of the firm's equity. All the variables needed to estimate both the retention ratio and ROE can be found on a firm's income statement and balance sheet. Third, security analysts commonly provide forecasts of future growth. However, analysts' estimates are generally for five-year growth rates in earnings, while the DDM requires long-term growth rates in dividends.

As an example of the third approach, the consensus five-year forecast for annual earnings growth, as recently reported on finance.yahoo.com, was 7.0 percent for Eastman Chemical Co. The company's dividend yield was 4.40 percent, implying an expected rate of return, and therefore a cost of capital, of $4.40 + 7 = 11.40\%$ for Eastman.

The above discussion shows how one can use the DDM to estimate a firm's cost of capital. How accurate is this approach compared to the CAPM? We examine this question in the section below.

### Comparison of DDM and CAPM

Both the dividend discount model and the capital asset pricing model are internally consistent models. Nevertheless, academics have generally favored the CAPM over the DDM. In addition, a recent study[8] reported that slightly fewer than three-fourths of companies use the CAPM to estimate the cost of equity capital, while slightly fewer than one-sixth of companies use the dividend discount model to do so. Why has the pendulum swung over to the CAPM?

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[8]John R. Graham and Campbell R. Harvey, "The Theory and Practice of Corporate Finance: Evidence from the Field," *Journal of Financial Economics* (2001), Table 3.

While no one, to our knowledge, has done a systematic comparison of the two approaches, the DDM appears to contain more measurement error than does the CAPM. The problem is that one is estimating the growth rate of an *individual company* in the DDM, and each of our three suggested approaches to estimate *g* is fraught with measurement error for single firms. In contrast, consider the calculation of the market risk premium in the CAPM, when the DDM is used to estimate *g* for the whole market. Though there is clearly measurement error here as well, the error is almost certainly far less; much of the measurement error when estimating *g* for individual companies is diversified away as we move from individual firms to the market as a whole.[9] Nevertheless, while we have been critical of the DDM's practical application, DDM provides some important intuition, as shown in the next section.

### Can a Low-Dividend or a No-Dividend Stock Have a High Cost of Capital?

While the Astra Electronics Corporation pays an annual dividend of $1, its stock price is $100, implying a dividend yield of 1 percent ($=1/100$). The management of the firm is about to embark on a large capital-budgeting campaign and needs to know its cost of capital. The CEO, Angela Green, says, "Our cost of capital is just our dividend yield, which is 1 percent. If we issue new stock to fund a capital budgeting project, we will have to pay our new stockholders $1 in dividends each year for every $100 we receive at issuance. As long as the project's annual cash flow will be above $1 for every $100 of investment, the existing stockholders will be better off. In other words, we should accept any project with an internal rate of return above 1 percent."

Is Ms. Green's reasoning correct? Given what we have just said about the dividend discount model, the answer must be a resounding no. The cash flow per share of Astra Electronics, like any firm, is likely to grow over time. This growth in cash flow should lead to a growth in dividends. Thus, while the new shareholders will receive only a $1 dividend in the first year for each $100 investment, they are likely to receive larger dividends in later years. Their total return will, therefore, be greater than 1 percent.

How much greater will their total return be? That's where the dividend discount model comes into play. If dividends are expected to grow at, say, 8 percent a year in perpetuity, the DDM tells us that the expected annual return on the stock is $1 + 8 = 9\%$.

Could some stock have a low-dividend yield, such as 1 percent, and yet have no growth potential at all? That would be quite surprising indeed. Stocks sell at high multiples relative to their dividends (i.e., have low-dividend yields) because the market believes that their dividends will grow at a high rate. As a counterexample, suppose the market believed that the cash flows of Astra Electronics would never grow, leading to a constant dividend of $1. In order to receive a return of, say, 9 percent, the market would price the stock at only $11.11 ($=1/.09$), not $100.

The same reasoning applies to firms that pay no dividends at all. Their cost of capital is not zero. Sure, the stockholders do not expect to get anything in the first year, or perhaps even in the first few years. However, the stockholders expect to receive dividends eventually, or, alternatively, to be bought out by an acquiring firm. The acquiring firm would pay a positive price, because it would anticipate withdrawing cash from the firm at some point.

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[9]Of course, there is more to the story since we have to estimate three parameters for the CAPM (risk-free rate, market risk premium, and beta), each one of which contains error. Beta estimation is generally considered the problem here, because we need a beta for each company. However, as mentioned earlier in the chapter, analysts frequently calculate average betas across the different companies in an industry in order to reduce measurement error. The presumption is that the betas of different firms in an industry are similar. By contrast, we should not calculate average values of *g* across the different firms in an industry. Even though these firms are in the same industry, their growth rates can differ widely.

# 12.7 COST OF CAPITAL FOR DIVISIONS AND PROJECTS

Previous sections of this chapter all assumed that the risk of a potential project is equal to the risk of the existing firm. How should we estimate the discount rate for a project whose risk differs from that of the firm? The answer is that each project should be discounted at a rate commensurate with its own risk. For example, let's assume that we use the CAPM to determine the discount rate.[10] If a project's beta differs from that of the firm, the project's cash flows should be discounted at a rate commensurate with the project's own beta. This is an important point, since firms frequently speak of a *corporate discount rate*. (As mentioned earlier, *required return* and *cost of capital* are frequently used synonymously.) Unless all projects in the corporation are of the same risk, choosing the same discount rate for all projects is incorrect.

The above paragraph considered the discount rates of individual projects. The same message would apply for whole divisions. If a corporation has a number of divisions, each in a different industry, it would be a mistake to assign the same discount rate to each division.

## Project Risk

D. D. Ronnelley Co., a publishing firm, may accept a project in computer software. Noting that computer software companies have high betas, the publishing firm views the software venture as more risky than the rest of its business. It should discount the project at a rate commensurate with the risk of software companies. For example, it might use the average beta of a portfolio of publicly traded software firms. Instead, if all projects in D. D. Ronnelley Co. were discounted at the same rate, a bias would result. The firm would accept too many high-risk projects (software ventures) and reject too many low-risk projects (books and magazines). This point is illustrated in Figure 12.5.

### FIGURE 12.5
Relationship between the Firm's Cost of Capital and the Security Market Line (SML)



A single cost of capital for all projects in a firm, as indicated by the horizontal line in the figure, may lead to incorrect capital budgeting decisions. Projects with high risk, such as the software venture for D. D. Ronnelley Co., should be discounted at a high rate. By using the firm's cost of capital, the firm is likely to accept too many high-risk projects.

Projects with low risk should be discounted at a low rate. By using the firm's cost of capital, the firm is likely to reject too many low-risk projects.

[10]For simplicity, we consider only the CAPM in this section. However, a similar approach would apply if the cost of capital were determined from the DDM.

The D. D. Ronnelley (DDR) example points out that we should discount a project at a rate commensurate with the risk of the project's cash flows. However, practitioners should be concerned with three issues here. First, they must choose the appropriate industry. While this may seem to be an easy task, the problem is that companies often have more than one line of business. For example, suppose that DDR was considering a project in the movie industry, not in computer software. Their first thought might be to look at the betas of the largest and most important companies in the film industry. The six biggest studios are Warner Brothers, Columbia, Fox, Universal, Paramount, and Disney. However, the first five studios are owned by Time-Warner, Sony, News Corporation, Comcast, and Viacom, respectively. These parent corporations are all diversified, with movies making up only a small portion of total revenues. And, while the parent of the sixth studio has the same Walt Disney name, it too is quite diversified, with holdings in television, radio, theme parks, and cruise ships. With all this diversification, it would likely be quite difficult to determine the beta of a pure moviemaking company from the betas of the six parents. Analysts often talk about identifying *pure plays* (i.e., other companies that specialize only in projects similar to the project your firm is considering). Pure plays are easier to find in some situations than in others.

Second, even if all companies in a particular industry are pure plays, the beta of a new project may be greater than the beta of existing firms, because a new project is likely to be particularly responsive to economy-wide movements. For example, a start-up computer venture may fail in a recession while IBM, Microsoft, or Oracle will still be around. Conversely, in an expansion, the venture may grow faster than the older computer firms.

Fortunately, a slight adjustment is all that is needed here. The new venture should be assigned a somewhat higher beta than that of the industry to reflect added risk. The adjustment is necessarily ad hoc, so no formula can be given. Our experience indicates that this approach is in widespread practice today.

Third, a problem arises for the rare project constituting its own industry. For example, consider the firms providing consumer shopping by television. Today, we can obtain a reasonable estimate for the beta of this industry because a few of the firms have publicly traded stock. However, when the ventures began in the 1980s, any beta estimate was suspect. At that time, no one knew whether shopping by TV belonged in the television industry, the retail industry, or in an entirely new industry.

What beta should be used when the project constitutes its own industry? Earlier in this chapter we mentioned three determinants of beta: Cyclicality of revenues, operating leverage, and financial leverage. Comparing the values of these three determinants for the project in question to the values for other firms should provide at least a general feel for the project's beta.

## 12.8 COST OF FIXED INCOME SECURITIES

In this section, we examine the cost of both debt and preferred stock. We consider the cost of debt first.

### Cost of Debt

The cost of equity is often difficult to estimate. The task generally involves a fair amount of data gathering and the end result is often measured with error. Fortunately, the cost of debt is much easier to determine; it is simply the cost of borrowing. The firm can generally obtain this information either by checking the yield on publicly traded bonds or by talking to commercial and investment bankers.

Two years ago, the Ritter Manufacturing Corp. (RMC) issued $100 million of debt with a 7 percent coupon. While the bonds were initially issued at par, rising interest rates over

the last two years have caused them to sell at a discount. The yield on the bonds is currently 8 percent. In order to finance expansion, RMC is considering another large issue of bonds. What is the cost of the new debt?

The cost of the new debt should be around 8 percent. If the old bonds are selling at 8 percent, the new debt will not sell at a lower yield. The 7 percent is merely a historical number, often called the *embedded cost* of the debt, with no relevance today.

Alternatively, perhaps a firm is issuing debt for the first time. Here, the firm's investment banker can generally indicate to the firm's managers what the yield on the prospective bonds will be. That yield can be used as an estimate of the cost of debt.[11] Or, perhaps the company will take out a loan with a commercial bank. Again, the borrowing rate on the prospective loan is the cost of debt.

There is only one complication that needs to be discussed. We have ignored taxes so far, obviously an assumption at odds with reality. Under U.S. tax law, interest payments are *tax deductible*. Consider the following example where two firms, Unlevered Corp. and Levered Corp., differ only in debt. Unlevered Corp. has no debt and Levered Corp. has $100 of debt, with an interest rate of 10 percent.

| UNLEVERED CORP. | | LEVERED CORP. | |
|---|---|---|---|
| Revenue | $180 | Revenue | $180 |
| Expenses | −70 | Expenses | −70 |
| Pretax earnings | 110 | Earnings before interest and taxes | 110 |
| Taxes (40% rate) | −44 | Interest (10% on $100 borrowed) | −10 |
| Aftertax earnings | $ 66 | Pretax earnings | 100 |
| | | Taxes (40% rate) | −40 |
| | | Aftertax earnings | $ 60 |

While the Levered Corp. must pay $10 of interest per year, its aftertax earnings are only $6 (=66 − 60) less than those of the Unlevered Corp. Why? Because the interest payments are tax deductible. That is, while Levered Corp.'s pretax earnings are $10 (=110 − 100) less than those of Unlevered Corp., Levered Corp. pays $4 (=44 − 40) less in taxes than does Unlevered Corp.

The $6 reduction of aftertax earnings is 6 percent of the $100 that Levered Corp. borrowed. Thus, the aftertax cost of debt is 6 percent. In general, the aftertax cost of debt can be written as:

**Aftertax cost of debt = (1 − Tax rate) × Borrowing rate**

**6% = (1 − .40) × 10%**

Why have we tax-adjusted the cost of debt while we did not tax-adjust the cost of equity? Because, while firms can deduct their interest payments before paying taxes, dividends are not tax deductible.

## Cost of Preferred Stock

The name preferred stock is an unfortunate one, because preferred stock is probably more similar to bonds than to common stock. Preferred stock pays a constant dividend in perpetuity. Interest payments on bonds are quite similar to dividends on preferred stock, though almost all bonds have a finite maturity. By contrast, dividends on common stock are not constant over time.

[11]A caveat is in order here. The current market yield will be higher than the return bondholders can expect to receive because of the possibility of default. For investment grade bonds the probability of default is negligible. However, for non-investment grade bonds the adjustments for the probability of default could be important.

Suppose a share of the preferred stock of Polytech, Inc. is selling at $17.16 and pays a dividend of $1.50 per year. Since preferred stocks are perpetuities, they should be priced by the perpetuity formula, $PV = C/R$, where $PV$ is the present value, or price, $C$ is the cash to be received each year, and $r$ is the yield, or rate of return. Rearranging, we have:

**R = C/PV**

For this preferred issue, the rate of return is 8.7% ($=1.50/17.16$). The cost of preferred stock is simply this rate of return.

Why don't we tax-adjust the cost of preferred stock the way we did the cost of debt? We don't tax-adjust here, because dividend payments on preferred stock are not tax deductible.

## 12.9 THE WEIGHTED AVERAGE COST OF CAPITAL

Sections 12.1 and 12.2 showed how to estimate the discount rate when a project is all equity financed. In this section, we discuss an adjustment when the project is financed with both debt and equity.

Suppose a firm uses both debt and equity to finance its investments. If the firm pays $R_B$ for its debt financing and $R_S$ for its equity, what is the overall or average cost of its capital? The cost of equity is $R_S$, as discussed in earlier sections. The cost of debt is the firm's borrowing rate, $R_B$, which we can often observe by looking at the yield to maturity on the firm's debt. If a firm uses both debt and equity, the cost of capital is a weighted average of each. This works out to be:

$$\frac{S}{S + B} \times R_S + \frac{B}{S + B} \times R_B$$

The weights in the formula are, respectively, the proportion of total value represented by equity:

$$\left(\frac{S}{S + B}\right)$$

and the proportion of total value represented by debt:

$$\left(\frac{B}{S + B}\right)$$

This is only natural. If the firm had issued no debt and was therefore an all-equity firm, its average cost of capital would equal its cost of equity, $R_S$. At the other extreme, if the firm had issued so much debt that its equity was valueless, it would be an all-debt firm, and its average cost of capital would be its cost of debt, $R_B$.

Interest is tax deductible at the corporate level, as stated in the previous section. The aftertax cost of debt is:

**Cost of debt (after corporate tax) = $R_B \times (1 - t_C)$**

where $t_C$ is the corporation's tax rate.

Assembling these results, we get the average cost of capital (after tax) for the firm.[12]

$$\textbf{Average cost of capital} = \left(\frac{S}{S + B}\right) \times R_S + \left(\frac{B}{S + B}\right) \times R_B \times (1 - t_C) \qquad [12.5]$$

[12]For simplicity, Equation 12.5 ignores preferred stock financing. With the addition of preferred stock, the formula becomes:

$$\text{Average cost of capital} = \frac{S}{S + B + P} \times R_S + \frac{B}{S + B + P} + R_B \times (1 - t_C)$$
$$+ \frac{P}{S + B + P} \times R_P$$

where $P$ is the percentage of preferred stock in the firm's capital structure and $R_P$ is the cost of preferred stock.

Because the average cost of capital weighs the cost of equity and the cost of debt, it is usually referred to as the **weighted average cost of capital, $R_{WACC}$**, and from now on we will use this term.

### WACC

Consider a firm whose debt has a market value of $40 million and whose stock has a market value of $60 million (3 million outstanding shares of stock, each selling for $20 per share). The firm pays a 5 percent rate of interest on its new debt and has a beta of 1.41. The corporate tax rate is 34 percent. (Assume that the security market line (SML) holds, that the risk premium on the market is 9.5 percent [somewhat higher than the historical equity risk premium], and that the current Treasury bill rate is 1 percent.) What is this firm's $R_{WACC}$?

To compute the $R_{WACC}$ using Equation 12.5, we must know (1) the aftertax cost of debt, $R_B \times (1 - t_C)$, (2) the cost of equity, $R_S$, and (3) the proportions of debt and equity used by the firm. These three values are determined next:

1.  The pretax cost of debt is 5 percent, implying an aftertax cost of 3.3 percent [$= 5\% \times (1 - .34)$].

2.  We calculate the cost of equity capital by using the SML:

$$R_S = R_F + \beta \times [R_M - R_F]$$
$$= 1\% + 1.41 \times 9.5\%$$
$$= 14.40\%$$

3.  We compute the proportions of debt and equity from the market values of debt and equity. Because the market value of the firm is $100 million ($= $40 million + $60 million), the proportions of debt and equity are 40 and 60 percent, respectively.

The cost of equity, $R_S$, is 14.40 percent, and the aftertax cost of debt, $R_B \times (1 - t_C)$, is 3.3 percent. $B$ is $40 million and $S$ is $60 million. Therefore:

$$R_{WACC} = \frac{S}{B + S} \times R_S + \frac{B}{B + S} \times R_B \times (1 - t_C)$$
$$= \left(\frac{40}{100} \times 3.3\%\right) + \left(\frac{60}{100} \times 14.40\%\right) = 9.96\%$$

The above calculations are presented in table form below:

| (1) FINANCING COMPONENTS | (2) MARKET VALUES | (3) WEIGHT | (4) COST OF CAPITAL (AFTER CORPORATE TAX) | (5) WEIGHTED COST OF CAPITAL |
|---|---|---|---|---|
| Debt | $ 40,000,000 | .40 | $5\% \times (1 - .34) = 3.3\%$ | 1.32% |
| Equity | 60,000,000 | .60 | $1\% + 1.41 \times 9.5\% = 14.40$ | 8.64 |
| | $100,000,000 | 1.00 | | 9.96% |

The weights used in the previous example are market value weights. Market value weights are more appropriate than book value weights because the market values of the securities are closer to the actual dollars that would be received from their sale. In fact, it is useful to think in terms of "target" market weights. These are the market weights expected to prevail over the life of the firm or project.

## THE COST OF CAPITAL, TEXAS STYLE

We have seen how the WACC is used in the corporate world. It is also used by state governments to value property for tax purposes. Property valuation can be tricky. The value of a home depends on what it could be sold for, which is not too hard to estimate, but how do you value an oil or gas field? For the Texas Comptroller of Public Accounts, the answer is to estimate the present value of the future cash flows of the property. As you know by now, the cost of capital depends on the use of funds, not the source of funds. So, Texas calculates the WACC for companies in the oil industry and adjusts the industry average WACC for company-specific factors. The table below shows the state's calculations for integrated oil companies.

**2008 Property Value Study: Discount Rate for Oil and Gas Properties**

**Table 1: Integrated Petroleum Companies' Financial Information Used for WACC Method**

| Company Name | Total Capital | Total Equity | Total Convertible Preferred Stock | Total Long-Term Debt | Equity % of Capital | Convertible Preferred Stock % of Capital | Long-Term Debt % of Capital | Beta Factor | After Income Tax Cost of Equity, % | Before Income Tax Cost of Equity, % | Cost of Convertible Preferred Stock % | Cost of Debt % | Before Income Tax WACC % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Anadarko | $44,093,920,000 | $30,742,920,000 | $0 | $13,351,000,000 | 69.72 | 0.000 | 30.28 | 0.90 | 10.50 | 16.16 | 0.00 | 5.58 | 12.95 |
| Apache | $39,814,600,712 | $35,802,995,712 | $0 | $4,011,605,000 | 89.92 | 0.000 | 10.08 | 0.90 | 10.50 | 16.16 | 0.00 | 5.52 | 15.09 |
| Chevron | $201,170,201,673 | $195,100,201,673 | $0 | $6,070,000,000 | 96.98 | 0.000 | 3.02 | 0.90 | 10.50 | 16.16 | 0.00 | 5.09 | 15.83 |
| Conoco Phillips | $159,046,299,817 | $138,757,299,817 | $0 | $20,289,000,000 | 87.24 | 0.000 | 12.76 | 0.90 | 10.50 | 16.16 | 0.00 | 5.01 | 14.74 |
| Exxon Mobil | $511,422,580,000 | $504,239,580,000 | $0 | $7,183,000,000 | 98.60 | 0.000 | 1.40 | 0.90 | 10.50 | 16.16 | 0.00 | 4.91 | 16.00 |
| Hess | $36,253,674,143 | $32,335,674,143 | $0 | $3,918,000,000 | 89.19 | 0.000 | 10.81 | 0.95 | 10.83 | 16.66 | 0.00 | 5.72 | 15.48 |
| Marathon | $49,294,600,000 | $43,210,600,000 | $0 | $6,084,000,000 | 87.66 | 0.000 | 12.34 | 1.05 | 11.48 | 17.66 | 0.00 | 5.36 | 16.14 |
| Murphy | $17,611,504,401 | $16,095,348,401 | $0 | $1,516,156,000 | 91.39 | 0.000 | 8.61 | 0.90 | 10.50 | 16.16 | 0.00 | 5.51 | 15.24 |
| Occidental | $65,350,408,558 | $63,573,408,558 | $0 | $1,777,000,000 | 97.28 | 0.000 | 2.72 | 1.05 | 11.48 | 17.66 | 0.00 | 5.01 | 17.31 |
| TOTAL | $1,124,057,789,304 | $1,059,858,028,304 | $0 | $64,199,761,000 | 807.99 | 0.000 | 92.01 | 8.45 | 96.81 | 148.93 | 0.00 | 47.70 | 138.78 |
| ENTRIES | | | | | 9 | 0 | 9 | 9 | 9 | 9 | 0 | 9 | 9 |
| AVERAGE | | | | | 89.78 | 0.000 | 10.22 | 0.94 | 10.76 | 16.55 | 0.00 | 5.30 | 15.42 |
| STANDARD DEVIATION | | | | | 8.68 | 0.000 | 8.68 | 0.07 | 0.42 | 0.65 | 0.00 | 0.30 | 1.19 |

As you can see, the WACC numbers for the companies are similar. Anadarko has the lowest WACC at 12.95 percent and Occidental has the highest at 17.31 percent, but most other companies are in the 15 to 16 percent range. The average WACC for a company in this industry is 15.42 percent, with a standard deviation of 1.19 percent. When Texas uses this calculation, a two percent adjustment factor is added, plus any property-specific risk adjustment. The range used by the state for 2008 was 17.25 percent to 22.68 percent, before any property-specific factors.

Notice that the Texas Comptroller of Public Accounts calculated these numbers on a pretax, rather than after-tax, basis. In other words, the state did not account for the tax deductibility of interest payments in this calculation. The reason is that the state adjusts the cost of capital for taxes on a company-by-company basis.

**EXAMPLE 12.6**

### Project Evaluation and the WACC

Suppose a firm has both a current and a target debt-equity ratio of .6, a cost of debt of 5.15 percent, and a cost of equity of 10 percent. The corporate tax rate is 34 percent. What is the firm's weighted average cost of capital?

Our first step calls for transforming the debt-equity ($B/S$) ratio to a debt-value ratio. A $B/S$ ratio of .6 implies 6 parts debt for 10 parts equity. Because value is equal to the sum of the debt plus the equity, the debt-value ratio is $6/(6 + 10) = .375$. Similarly, the equity-value ratio is $10/(6 + 10) = .625$. The $R_{WACC}$ will then be:

$$R_{WACC} = \left( \frac{S}{S + B} \right) \times R_S + \left( \frac{B}{S + B} \right) \times R_B \times (1 - t_C)$$

$$= .625 \times 10\% + .375 \times 5.15\% \times .66 = 7.52\%$$

Suppose the firm is considering taking on a warehouse renovation costing $60 million that is expected to yield cost savings of $12 million a year for six years. Using the NPV equation and discounting the six years of expected cash flows from the renovation at the $R_{WACC}$, we have:

$$NPV = -\$60 + \frac{\$12}{(1 + R_{WACC})} + \cdots + \frac{\$12}{(1 + R_{WACC})^6}$$

$$= -\$60 + \$12 + A^6_{.0752}$$

$$= -\$60 + (12 + 4.69)$$

$$= -\$3.71$$

Should the firm take on the warehouse renovation? The project has a negative NPV using the firm's $R_{WACC}$. This means that the financial markets offer superior investments in the same risk class (namely, the firm's risk class). The answer is clear: The firm should reject the project.

## 12.10 ESTIMATING EASTMAN CHEMICAL'S COST OF CAPITAL

In our previous sections, we calculated the cost of capital in examples. A nearby *The Real World* box shows the cost of capital in several part petroleum companies. We will now calculate the cost of capital for a particular real company, Eastman Chemical Co., a leading international chemical company and maker of plastics for soft drink containers and other uses. It was created in 1993, when its former parent company, Eastman Kodak, split off the division as a separate company.

**EASTMAN'S COST OF EQUITY**   Our first stop for Eastman is finance.yahoo.com (ticker: "EMN"). As of December 2009 the relevant data are in the next two tables.

**EASTMAN CHEM CO** (NYSE: EMN)

After Hours: 58.6652 ↓−0.03 (−0.06%) 4:12pm ET

| Last Trade: | 58.70 | Day's Range: | 58.38–59.27 |
|---|---|---|---|
| Trade Time: | 4:01pm ET | 52wk Range: | 17.76–61.95 |
| Change: | ↓ 0.77 (1.29%) | Volume: | 1,388,885 |
| Prev Close: | 59.47 | Avg Vol (3m): | 1,080,210 |
| Open: | 58.79 | Market Cap: | 4.27B |
| Bid: | N/A | P/E (ttm): | 25.84 |
| Ask: | N/A | EPS (ttm): | 2.27 |
| 1y Target Est: | 61.71 | Div & Yield: | 1.76 (2.90%) |

| Stock Price History | |
|---|---|
| Beta: | 2.01 |
| 52-Week Change: | 98.37% |
| S&P500 52-Week Change: | 21.28% |
| 52-Week High (04-Dec-09): | 61.95 |
| 52-Week Low (06-Mar-09): | 17.76 |
| 50-Day Moving Average: | 57.69 |
| 200-Day Moving Average: | 49.83 |
| **Share Statistics** | |
| Average Volume (3 month): | 1,080,210 |
| Average Volume (10 day): | 985,117 |
| Shares Outstanding: | 72.71M |
| Float: | 72.13M |
| % Held by Insiders: | 13.68% |
| % Held by Institutions: | 78.10% |
| Shares Short (as of 13-Nov-09): | 7.93M |

According to this screen, the market capitalization of EMN's equity, which is share price times number of shares outstanding, is $4.27 billion.

To estimate Eastman's cost of equity, we will assume a market risk premium of 7 percent and a risk-free rate of .75%. Eastman's beta on finance.yahoo.com is 2.01.

Using Eastman's beta in the CAPM to estimate the cost of equity,[13] we find:

$$R_s = .0075 + 2.01 \times .07 = .1482 \text{ or } 14.82\%$$

**EASTMAN'S COST OF DEBT**   Eastman has five long-term bond issues that account for essentially all of its long-term debt. To calculate the cost of debt, we will have to combine these five issues and compute a weighted average. We go to www.nasdbondinfo.com to find quotes on the bonds. We should note here that finding the yield to maturity for all of a company's outstanding bond issues on a single day is unusual. In our previous discussion on bonds, we found that the bond market is not as liquid as the stock market, and on many days, individual bond issues may not trade. To find the book value of the bonds, we go to www.sec.gov and find the most recent 10K report. The basic information is as follows:

| COUPON RATE | MATURITY | BOOK VALUE (FACE VALUE IN $ MILLIONS) | PRICE (AS % OF PAR) | YIELD TO MATURITY |
|---|---|---|---|---|
| 7.00% | 2012 | $154 | 105.000% | 4.728% |
| 6.30 | 2018 | 207 | 103.000 | 5.867 |
| 7.25 | 2024 | 497 | 110.011 | 6.164 |
| 7.625 | 2024 | 200 | 117.090 | 5.861 |
| 7.60 | 2027 | 298 | 109.412 | 6.670 |

To calculate the weighted average cost of debt, we take the percentage of the total debt represented by each issue and multiply by the yield on the issue. We then add to get the overall weighted average debt cost. We use both book values and market values here for comparison. The results of the calculations are as follows:

| COUPON RATE | BOOK VALUE (FACE VALUE IN $ MILLIONS) | PERCENTAGE OF TOTAL | MARKET VALUE (IN $ MILLIONS) | PERCENTAGE OF TOTAL | YIELD TO MATURITY | BOOK VALUE WEIGHTS | MARKET VALUE WEIGHTS |
|---|---|---|---|---|---|---|---|
| 7.00% | $  154 | 11.36% | $  161.70 | 10.92% | 4.73 | .54% | .52% |
| 6.30 | 207 | 15.27 | 212.22 | 14.32 | 5.87 | .90 | .84 |
| 7.25 | 497 | 36.65 | 546.76 | 36.92 | 6.16 | 2.25 | 2.27 |
| 7.625 | 200 | 14.75 | 234.18 | 15.81 | 5.86 | .86 | .93 |
| 7.60 | 298 | 21.97 | 326.05 | 22.01 | 6.67 | 1.47 | 1.47 |
| Total | $1,356 | 100.00% | $1,480.91 | 100.00% | | 6.06% | 6.03% |

As these calculations show, Eastman's cost of debt is 6.06 percent on a book value basis and 6.03 percent on a market value basis. Thus, for Eastman, whether market values or book values are used makes little difference. The reason is simply that the market values and book values are similar. This will often be the case and explains why companies frequently use book values for debt in WACC calculations. We will, however, use market values in our calculations, because the market reflects current values.

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[13]Alternatively, one might use an average beta across all companies in the chemical industry, after properly adjusting for leverage. Some argue this averaging approach provides more accuracy, since errors in beta estimation for a single firm are reduced.

**EASTMAN'S WACC**  We now have the various pieces necessary to calculate Eastman's WACC. First, we need to calculate the capital structure weights.

The market values of Eastman's debt and equity are $1.481 billion and $4.27 billion, respectively. The total value of the firm is $5.751 billion, implying that the debt and equity percentages are $1.481/5.751 = .258$ and $4.27/5.751 = .742$, respectively. Assuming a tax rate of 35 percent, Eastman's WACC is:

$$R_{WACC} = .258 \times .0603 \times (1 - .35) + .742 \times .1482 = .12 \text{ or } 12\%$$

## 12.11  FLOTATION COSTS AND THE WEIGHTED AVERAGE COST OF CAPITAL

So far, we have not included issue costs in our discussion of the weighted average cost of capital. When projects are funded by stocks and bonds, the firm will incur these costs, which are commonly called *flotation costs*.

Sometimes it is suggested that the firm's WACC should be adjusted upward to reflect flotation costs. This is really not the best approach because the required return on an investment depends on the risk of the investment, not the source of the funds. This is not to say that flotation costs should be ignored. Since these costs arise as a consequence of the decision to undertake a project, they are relevant cash flows. We therefore briefly discuss how to include them in project analysis.

### The Basic Approach

We start with a simple case. The Spatt Company, an all-equity firm, has a cost of equity of 20 percent. Because this firm is 100 percent equity, its WACC and its cost of equity are the same. Spatt is contemplating a large-scale $100 million expansion of its existing operations. The expansion would be funded by selling new stock.

Based on conversations with its investment banker, Spatt believes its flotation costs will run 10 percent of the amount issued. This means that Spatt's proceeds from the equity sale will be only 90 percent of the amount sold. When flotation costs are considered, what is the cost of the expansion?

Spatt needs to sell enough equity to raise $100 million *after* covering the flotation costs. In other words:

$$\$100 \text{ million} = (1 - .10) \times \text{Amount raised}$$
$$\text{Amount raised} = \$100 \text{ million}/.90 = \$111.11 \text{ million}$$

Spatt's flotation costs are thus $11.11 million, and the true cost of the expansion is $111.11 million including flotation costs.

Things are only slightly more complicated if the firm uses both debt and equity. For example, suppose Spatt's target capital structure is 60 percent equity, 40 percent debt. The flotation costs associated with equity are still 10 percent, but the flotation costs for debt are less—say 5 percent.

Earlier, when we had different capital costs for debt and equity, we calculated a weighted average cost of capital using the target capital structure weights. Here, we will do much the same thing. We can calculate an overall or weighted average flotation cost, $f_o$, by multiplying the flotation cost for stock, $f_S$, by the percentage of stock ($S/V$) and the flotation cost for bonds, $f_B$, by the percentage of bonds ($B/V$) and then adding the two together:

$$
\begin{aligned}
f_o &= (S/V) \times f_S + (B/V) \times f_B \\
&= 60\% \times .10 + 40\% \times .05 \\
&= 8\%
\end{aligned}
\qquad \text{[12.6]}
$$

The weighted average flotation cost is thus 8 percent. What this tells us is that for every dollar in outside financing needed for new projects, the firm must actually raise

$1/(1 - .08) = \$1.087$. In our example, the project cost is $100 million when we ignore flotation costs. If we include them, then the true cost is $100 million/$(1 - f_o) = \$100$ million/.92 = \$108.7 million.

In taking issue costs into account, the firm must be careful not to use the wrong weights. The firm should use the target weights, even if it can finance the entire cost of the project with either debt or equity. The fact that a firm can finance a specific project with debt or equity is not directly relevant. If a firm has a target debt-equity ratio of 1, for example, but chooses to finance a particular project with all debt, it will have to raise additional equity later on to maintain its target debt-equity ratio. To take this into account, the firm should always use the target weights in calculating the flotation cost.

### Calculating the Weighted Average Flotation Cost

The Weinstein Corporation has a target capital structure of 80 percent equity and 20 percent debt. The flotation costs for equity issues are 20 percent of the amount raised; the flotation costs for debt issues are 6 percent. If Weinstein needs $65 million for a new manufacturing facility, what is the true cost including flotation costs?

We first calculate the weighted average flotation cost, $f_o$:

$$f_o = S/V \times f_S + B/V \times f_B$$
$$= 80\% \times .20 + 20\% \times .06$$
$$= 17.2\%$$

The weighted average flotation cost is 17.2 percent. The project cost is $65 million without flotation costs. If we include them, then the true cost is $65 million/$(1 - f_o) = \$65$ million/.828 = \$78.5 million, again illustrating that flotation costs can be a considerable expense.

## Flotation Costs and NPV

To illustrate how flotation costs can be included in an NPV analysis, suppose the Tripleday Printing Company is currently at its target debt-equity ratio of 100 percent. It is considering building a new $500,000 printing plant in Kansas. This new plant is expected to generate aftertax cash flows of $73,150 per year forever. The tax rate is 34 percent. There are two financing options:

1. A $500,000 new issue of common stock: The issuance costs of the new common stock would be about 10 percent of the amount raised. The required return on the company's new equity is 20 percent.

2. A $500,000 issue of 30-year bonds: The issuance costs of the new debt would be 2 percent of the proceeds. The company can raise new debt at 10 percent.

What is the NPV of the new printing plant?

To begin, since printing is the company's main line of business, we will use the company's weighted average cost of capital, $R_{WACC}$, to value the new printing plant:

$$R_{WACC} = S/V \times R_S + B/V \times R_B \times (1 - t_c)$$
$$= .50 \times 20\% + .50 \times 10\% \times (1 - .34)$$
$$= 13.3\%$$

Because the cash flows are $73,150 per year forever, the PV of the cash flows at 13.3 percent per year is:

$$PV = \frac{\$73,150}{.133} = \$550,000$$

If we ignore flotation costs, the NPV is:

$$\text{NPV} = \$550{,}000 - 500{,}000 = \$50{,}000$$

With no flotation costs, the project generates an NPV that is greater than zero, so it should be accepted.

What about financing arrangements and issue costs? Because new financing must be raised, the flotation costs are relevant. From the information given, we know that the flotation costs are 2 percent for debt and 10 percent for equity. Because Tripleday uses equal amounts of debt and equity, the weighted average flotation cost, $f_o$, is:

$$f_o = S/V \times f_S + B/V \times f_B$$
$$= .50 \times 10\% + .50 \times 2\%$$
$$= 6\%$$

Remember, the fact that Tripleday can finance the project with all debt or all equity is irrelevant. Since Tripleday needs \$500,000 to fund the new plant, the true cost, once we include flotation costs, is $\$500{,}000/(1 - f_o) = \$500{,}000/.94 = \$531{,}915$. Because the PV of the cash flows is \$550,000, the plant has an NPV of $\$550{,}000 - 531{,}915 = \$18{,}085$, so it is still a good investment. However, its value is less than we initially might have thought.

### Internal Equity and Flotation Costs

Our discussion of flotation costs to this point implicitly assumes that firms always have to raise the capital needed for new investments. In reality, most firms rarely sell equity at all. Instead, their internally generated cash flow is sufficient to cover the equity portion of their capital spending. Only the debt portion must be raised externally.

The use of internal equity doesn't change our approach. However, we now assign a value of zero to the flotation cost of equity because there is no such cost. In our Tripleday example, the weighted average flotation cost would therefore be:

$$f_o = S/V \times f_S + B/V \times f_B$$
$$= .50 \times 0\% + .50 \times 2\%$$
$$= 1\%$$

Notice that whether equity is generated internally or externally makes a big difference because external equity has a relatively high flotation cost.

## SUMMARY AND CONCLUSIONS

Earlier chapters on capital budgeting assumed that projects generate riskless cash flows. The appropriate discount rate in that case is the riskless interest rate. Of course, most cash flows from real-world capital budgeting projects are risky. This chapter discussed the discount rate when cash flows are risky.

1. A firm with excess cash can either pay a dividend or make a capital expenditure. Because stockholders can reinvest the dividend in risky financial assets, the expected return on a capital budgeting project should be at least as great as the expected return on a financial asset of comparable risk.

2. The expected return on any asset is dependent on its beta. Thus, we showed how to estimate the beta of a stock. The appropriate procedure employs regression analysis on historical returns.

3. Both beta and covariance measure the responsiveness of a security to movements in the market. Correlation and beta measure different concepts. Beta is the slope of the regression line and correlation is the tightness of fit around the regression line.

4. We considered the case of a project with beta risk equal to that of the firm. If the firm is unlevered, the discount rate on the project is equal to:

$$R_F + \beta \times (R_M - R_F)$$

where $R_M$ is the expected return on the market portfolio and $R_F$ is the risk-free rate. In words, the discount rate on the project is equal to the CAPM's estimate of the expected return on the security.

5. The beta of a company is a function of a number of factors. Perhaps the three most important are:

   • Cyclicality of revenues.

   • Operating leverage.

   • Financial leverage.

6. If the project's beta differs from that of the firm, the discount rate should be based on the project's beta. We can generally estimate the project's beta by determining the average beta of the project's industry.

7. Sometimes we cannot use the average beta of the project's industry as an estimate of the beta of the project. For example, a new project may not fall neatly into any existing industry. In this case, we can estimate the project's beta by considering the project's cyclicality of revenues and its operating leverage. This approach is qualitative.

8. If a firm uses debt, the discount rate to use is the $R_{WACC}$. To calculate $R_{WACC}$, we must estimate the cost of equity and the cost of debt applicable to a project. If the project is similar to the firm, the cost of equity can be estimated using the SML for the firm's equity. Conceptually, a dividend growth model could be used as well, though it is likely to be far less accurate in practice.

9. New projects are often funded by bonds and stock. The costs of issuance, generally called flotation costs, should be included in any NPV analysis.

## CONCEPT QUESTIONS

1. **Project Risk**    If you can borrow all the money you need for a project at 6 percent, doesn't it follow that 6 percent is your cost of capital for the project?

2. **WACC and Taxes**    Why do we use an aftertax figure for cost of debt but not for cost of equity?

3. **SML Cost of Equity Estimation**    If you use the stock beta and the security market line to compute the discount rate for a project, what assumptions are you implicitly making?

4. **SML Cost of Equity Estimation**    What are the advantages of using the SML approach to finding the cost of equity capital? What are the disadvantages? What are the specific pieces of information needed to use this method? Are all of these variables observable, or do they need to be estimated? What are some of the ways in which you could get these estimates?

5. **Cost of Debt Estimation**    How do you determine the appropriate cost of debt for a company? Does it make a difference if the company's debt is privately placed as opposed to being publicly traded? How would you estimate the cost of debt for a firm whose only debt issues are privately held by institutional investors?

6. **Cost of Capital**   Suppose Tom O'Bedlam, president of Bedlam Products, Inc., has hired you to determine the firm's cost of debt and cost of equity capital.

   a. The stock currently sells for $50 per share, and the dividend per share will probably be about $5. Tom argues, "It will cost us $5 per share to use the stockholders' money this year, so the cost of equity is equal to 10 percent (=$5/50)." What's wrong with this conclusion?

   b. Based on the most recent financial statements, Bedlam Products' total liabilities are $8 million. Total interest expense for the coming year will be about $1 million. Tom therefore reasons, "We owe $8 million, and we will pay $1 million interest. Therefore, our cost of debt is obviously $1 million/8 million = 12.5 percent." What's wrong with this conclusion?

   c. Based on his own analysis, Tom is recommending that the company increase its use of equity financing because, "debt costs 12.5 percent, but equity only costs 10 percent; thus equity is cheaper." Ignoring all the other issues, what do you think about the conclusion that the cost of equity is less than the cost of debt?

7. **Company Risk versus Project Risk**   Both Dow Chemical Company, a large natural gas user, and Superior Oil, a major natural gas producer, are thinking of investing in natural gas wells near Houston. Both are all equity financed companies. Dow and Superior are looking at identical projects. They've analyzed their respective investments, which would involve a negative cash flow now and positive expected cash flows in the future. These cash flows would be the same for both firms. No debt would be used to finance the projects. Both companies estimate that their projects would have a net present value of $1 million at an 18 percent discount rate and a −$1.1 million NPV at a 22 percent discount rate. Dow has a beta of 1.25, whereas Superior has a beta of .75. The expected risk premium on the market is 8 percent, and risk-free bonds are yielding 12 percent. Should either company proceed? Should both? Explain.

8. **Divisional Cost of Capital**   Under what circumstances would it be appropriate for a firm to use different costs of capital for its different operating divisions? If the overall firm WACC was used as the hurdle rate for all divisions, would the riskier divisions or the more conservative divisions tend to get most of the investment projects? Why? If you were to try to estimate the appropriate cost of capital for different divisions, what problems might you encounter? What are two techniques you could use to develop a rough estimate for each division's cost of capital?

9. **Leverage**   Consider a levered firm's projects that have similar risks to the firm as a whole. Is the discount rate for the projects higher or lower than the rate computed using the security market line? Why?

10. **Beta**   What factors determine the beta of a stock? Define and describe each.

## QUESTIONS AND PROBLEMS

1. **Calculating Cost of Equity**   The Dybvig Corporation's common stock has a beta of 1.15. If the risk-free rate is 4.5 percent and the expected return on the market is 11 percent, what is Dybvig's cost of equity capital?

2. **Calculating Cost of Equity**   The Devon Co. just issued a dividend of $2.40 per share on its common stock. The company is expected to maintain a constant 5.5 percent growth rate in its dividends indefinitely. If the stock sells for $52 a share, what is the company's cost of equity?

3. **Calculating Cost of Equity**   Stock in Country Road Industries has a beta of .85. The market risk premium is 8 percent, and T-bills are currently yielding 5 percent. The company's most recent dividend was $1.60 per share, and dividends are expected to grow at a 6 percent annual rate indefinitely. If the stock sells for $37 per share, what is your best estimate of the company's cost of equity?

**connect**

**Basic**
(Questions 1–17)

4. **Calculating Cost of Debt**   Advance, Inc., is trying to determine its cost of debt. The firm has a debt issue outstanding with 12 years to maturity that is quoted at 95 percent of face value. The issue makes semiannual payments and has a coupon rate of 8 percent annually. What is Advance's pretax cost of debt? If the tax rate is 35 percent, what is the aftertax cost of debt?

5. **Calculating Cost of Debt**   Shanken Corp. issued a 30-year, 7 percent semiannual bond 7 years ago. The bond currently sells for 108 percent of its face value. The company's tax rate is 35 percent.

   **a.** What is the pretax cost of debt?

   **b.** What is the aftertax cost of debt?

   **c.** Which is more relevant, the pretax or the aftertax cost of debt? Why?

6. **Calculating Cost of Debt**   For the firm in the previous problem, suppose the book value of the debt issue is $60 million. In addition, the company has a second debt issue on the market, a zero coupon bond with seven years left to maturity; the book value of this issue is $80 million and the bonds sell for 73 percent of par. What is the company's total book value of debt? The total market value? What is your best estimate of the aftertax cost of debt now?

7. **Calculating WACC**   Mullineaux Corporation has a target capital structure of 70 percent common stock and 30 percent debt. Its cost of equity is 15 percent, and the cost of debt is 8 percent. The relevant tax rate is 35 percent. What is Mullineaux's WACC?

8. **Taxes and WACC**   Miller Manufacturing has a target debt-equity ratio of .45. Its cost of equity is 17 percent, and its cost of debt is 10 percent. If the tax rate is 35 percent, what is Miller's WACC?

9. **Finding the Capital Structure**   Fama's Llamas has a weighted average cost of capital of 9.8 percent. The company's cost of equity is 15 percent, and its cost of debt is 7.5 percent. The tax rate is 35 percent. What is Fama's debt-equity ratio?

10. **Book Value versus Market Value**   Filer Manufacturing has 7.5 million shares of common stock outstanding. The current share price is $49, and the book value per share is $4. Filer Manufacturing also has two bond issues outstanding. The first bond issue has a face value of $60 million and a 7 percent coupon and sells for 93 percent of par. The second issue has a face value of $50 million and a 6.5 percent coupon and sells for 96.5 percent of par. The first issue matures in 10 years, the second in 6 years.

    **a.** What are Filer's capital structure weights on a book value basis?

    **b.** What are Filer's capital structure weights on a market value basis?

    **c.** Which are more relevant, the book or market value weights? Why?

11. **Calculating the WACC**   In the previous problem, suppose the company's stock has a beta of 1.2. The risk-free rate is 5.2 percent, and the market risk premium is 7 percent. Assume that the overall cost of debt is the weighted average implied by the two outstanding debt issues. Both bonds make semiannual payments. The tax rate is 35 percent. What is the company's WACC?

12. **WACC**   Kose, Inc., has a target debt-equity ratio of .65. Its WACC is 11.2 percent, and the tax rate is 35 percent.

    **a.** If Kose's cost of equity is 15 percent, what is its pretax cost of debt?

    **b.** If instead you know that the aftertax cost of debt is 6.4 percent, what is the cost of equity?

13. **Finding the WACC**   Given the following information for Huntington Power Co., find the WACC. Assume the company's tax rate is 35 percent.

    | *Debt:* | 5,000 8 percent coupon bonds outstanding, $1,000 par value, 20 years to maturity, selling for 103 percent of par; the bonds make semiannual payments. |
    |---|---|

| | | |
|---|---|---|
| *Common stock:* | 160,000 shares outstanding, selling for $57 per share; the beta is 1.10. | |
| *Market:* | 7 percent market risk premium and 6 percent risk-free rate. | |

14. **Finding the WACC**    Titan Mining Corporation has 8.5 million shares of common stock outstanding and 200,000 7.5 percent semiannual bonds outstanding, par value $1,000 each. The common stock currently sells for $34 per share and has a beta of 1.20, and the bonds have 15 years to maturity and sell for 93 percent of par. The market risk premium is 7 percent, T-bills are yielding 5 percent, and Titan Mining's tax rate is 35 percent.

   a. What is the firm's market value capital structure?

   b. If Titan Mining is evaluating a new investment project that has the same risk as the firm's typical project, what rate should the firm use to discount the project's cash flows?

15. **SML and WACC**    An all-equity firm is considering the following projects:

| PROJECT | BETA | IRR |
|---------|------|------|
| W | .75 | 10.0% |
| X | .90 | 10.2 |
| Y | 1.20 | 12.0 |
| Z | 1.50 | 15.0 |

   The T-bill rate is 5 percent, and the expected return on the market is 11 percent.

   a. Which projects have a higher expected return than the firm's 11 percent cost of capital?

   b. Which projects should be accepted?

   c. Which projects would be incorrectly accepted or rejected if the firm's overall cost of capital was used as a hurdle rate?

16. **Calculating Flotation Costs**    Suppose your company needs $20 million to build a new assembly line. Your target debt-equity ratio is .75. The flotation cost for new equity is 8 percent, but the flotation cost for debt is only 5 percent. Your boss has decided to fund the project by borrowing money because the flotation costs are lower and the needed funds are relatively small.

   a. What do you think about the rationale behind borrowing the entire amount?

   b. What is your company's weighted average flotation cost, assuming all equity is raised externally?

   c. What is the true cost of building the new assembly line after taking flotation costs into account? Does it matter in this case that the entire amount is being raised from debt?

17. **Calculating Flotation Costs**    Southern Alliance Company needs to raise $45 million to start a new project and will raise the money by selling new bonds. The company will generate no internal equity for the foreseeable future. The company has a target capital structure of 65 percent common stock, 5 percent preferred stock, and 30 percent debt. Flotation costs for issuing new common stock are 9 percent, for new preferred stock, 6 percent, and for new debt, 3 percent. What is the true initial cost figure Southern should use when evaluating its project?

18. **WACC and NPV**    Och, Inc., is considering a project that will result in initial aftertax cash savings of $3.5 million at the end of the first year, and these savings will grow at a rate of 5 percent per year indefinitely. The firm has a target debt-equity ratio of .65, a cost of equity of 15 percent, and an aftertax cost of debt of 5.5 percent. The cost-saving proposal is somewhat riskier than the usual projects the firm undertakes; management uses the subjective approach and applies an adjustment factor of $+2$ percent to the cost of capital for such risky projects. Under what circumstances should Och take on the project?

**Intermediate**
(Questions 18–21)

19. **Preferred Stock and WACC**   The Saunders Investment Bank has the following financing outstanding. What is the WACC for the company?

| | |
|---|---|
| *Debt:* | 40,000 bonds with a 7 percent coupon rate and a current price quote of 119.80; the bonds have 25 years to maturity. 150,000 zero coupon bonds with a price quote of 18.2 and 30 years until maturity. |
| *Preferred stock:* | 100,000 shares of 4 percent preferred stock with a current price of $78, and a par value = $100. |
| *Common stock:* | 1,800,000 shares of common stock; the current price is $65, and the beta of the stock is 1.1. |
| *Market:* | The corporate tax rate is 40 percent, the market risk premium is 7 percent, and the risk-free rate is 4 percent. |

20. **Flotation Costs**   Goodbye, Inc., recently issued new securities to finance a new TV show. The project cost $15 million, and the company paid $850,000 in flotation costs. In addition, the equity issued had a flotation cost of 7 percent of the amount raised, whereas the debt issued had a flotation cost of 3 percent of the amount raised. If Goodbye issued new securities in the same proportion as its target capital structure, what is the company's target debt-equity ratio?

21. **Calculating the Cost of Equity**   Floyd Industries stock has a beta of 1.50. The company just paid a dividend of $.80, and the dividends are expected to grow at 5 percent per year. The expected return on the market is 12 percent, and Treasury bills are yielding 5.5 percent. The most recent stock price for Floyd is $61.

a. Calculate the cost of equity using the DDM method.

b. Calculate the cost of equity using the SML method.

c. Why do you think your estimates in (a) and (b) are so different?

**Challenge**
(Questions 22–24)

22. **Flotation Costs and NPV**   Photochronograph Corporation (PC) manufactures time series photographic equipment. It is currently at its target debt-equity ratio of .70. It's considering building a new $45 million manufacturing facility. This new plant is expected to generate aftertax cash flows of $6.2 million a year in perpetuity. The company raises all equity from outside financing. There are three financing options:

1. *A new issue of common stock:*   The flotation costs of the new common stock would be 8 percent of the amount raised. The required return on the company's new equity is 14 percent.

2. *A new issue of 20-year bonds:*   The flotation costs of the new bonds would be 4 percent of the proceeds. If the company issues these new bonds at an annual coupon rate of 8 percent, they will sell at par.

3. *Increased use of accounts payable financing:*   Because this financing is part of the company's ongoing daily business, it has no flotation costs, and the company assigns it a cost that is the same as the overall firm WACC. Management has a target ratio of accounts payable to long-term debt of .20. (Assume there is no difference between the pretax and aftertax accounts payable cost.)

What is the NPV of the new plant? Assume that PC has a 35 percent tax rate.

23. **Flotation Costs**   Trower Corp. has a debt-equity ratio of 1.20. The company is considering a new plant that will cost $145 million to build. When the company issues new equity, it incurs a flotation cost of 8 percent. The flotation cost on new debt is 3.5 percent. What is the initial cost of

the plant if the company raises all equity externally? What if it typically uses 60 percent retained earnings? What if all equity investments are financed through retained earnings?

24. **Project Evaluation**    This is a comprehensive project evaluation problem bringing together much of what you have learned in this and previous chapters. Suppose you have been hired as a financial consultant to Defense Electronics, Inc. (DEI), a large, publicly traded firm that is the market share leader in radar detection systems (RDSs). The company is looking at setting up a manufacturing plant overseas to produce a new line of RDSs. This will be a five-year project. The company bought some land three years ago for $4 million in anticipation of using it as a toxic dump site for waste chemicals, but it built a piping system to safely discard the chemicals instead. The land was appraised last week for $5.1 million. In five years, the aftertax value of the land will be $6 million, but the company expects to keep the land for a future project. The company wants to build its new manufacturing plant on this land; the plant and equipment will cost $35 million to build. The following market data on DEI's securities are current:

| | |
|---|---|
| *Debt:* | 240,000 7.5 percent coupon bonds outstanding, 20 years to maturity, selling for 94 percent of par; the bonds have a $1,000 par value each and make semiannual payments. |
| *Common stock:* | 9,000,000 shares outstanding, selling for $71 per share; the beta is 1.2. |
| *Preferred stock:* | 400,000 shares of 5.5 percent preferred stock outstanding, selling for $81 per share. |
| *Market:* | 8 percent expected market risk premium; 5 percent risk-free rate. |

DEI uses G.M. Wharton as its lead underwriter. Wharton charges DEI spreads of 8 percent on new common stock issues, 6 percent on new preferred stock issues, and 4 percent on new debt issues. Wharton has included all direct and indirect issuance costs (along with its profit) in setting these spreads. Wharton has recommended to DEI that it raise the funds needed to build the plant by issuing new shares of common stock. DEI's tax rate is 35 percent. The project requires $1,300,000 in initial net working capital investment to get operational. Assume Wharton raises all equity for new projects externally.

a. Calculate the project's initial time 0 cash flow, taking into account all side effects.

b. The new RDS project is somewhat riskier than a typical project for DEI, primarily because the plant is being located overseas. Management has told you to use an adjustment factor of +2 percent to account for this increased riskiness. Calculate the appropriate discount rate to use when evaluating DEI's project.

c. The manufacturing plant has an eight-year tax life, and DEI uses straight-line depreciation. At the end of the project (that is, the end of year 5), the plant and equipment can be scrapped for $6 million. What is the aftertax salvage value of this plant and equipment?

d. The company will incur $7,000,000 in annual fixed costs. The plan is to manufacture 18,000 RDSs per year and sell them at $10,900 per machine; the variable production costs are $9,400 per RDS. What is the annual operating cash flow (OCF) from this project?

e. DEI's comptroller is primarily interested in the impact of DEI's investments on the bottom line of reported accounting statements. What will you tell her is the accounting break-even quantity of RDSs sold for this project?

f. Finally, DEI's president wants you to throw all your calculations, assumptions, and everything else into the report for the chief financial officer; all he wants to know is what the RDS project's internal rate of return (IRR) and net present value (NPV) are. What will you report?
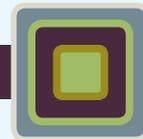
# THE COST OF CAPITAL FOR GOFF COMPUTER, INC.

You have recently been hired by Goff Computer, Inc. (GCI), in the finance area. GCI was founded eight years ago by Chris Goff and currently operates 74 stores in the Southeast. GCI is privately owned by Chris and his family and had sales of $97 million last year.

GCI sells primarily to in-store customers. Customers come to the store and talk with a sales representative. The sales representative assists the customer in determining the type of computer and peripherals that are necessary for the individual customer's computing needs. After the order is taken, the customer pays for the order immediately, and the computer is assembled to fill the order. Delivery of the computer averages 15 days but is guaranteed in 30 days.

GCI's growth to date has been financed from its profits. Whenever the company had sufficient capital, it would open a new store. Relatively little formal analysis has been used in the capital budgeting process. Chris has just read about capital budgeting techniques and has come to you for help. The company has never attempted to determine its cost of capital, and Chris would like you to perform the analysis. Because the company is privately owned, it is difficult to determine the cost of equity for the company. You have determined that to estimate the cost of capital for GCI, you will use Dell as a representative company. The following steps will allow you to calculate this estimate:

1. Most publicly traded corporations are required to submit 10Q (quarterly) and 10K (annual) reports to the SEC detailing their financial operations over the previous quarter or year, respectively. These corporate filings are available on the SEC Web site at www.sec.gov. Go to the SEC Web site, follow the "Search for Company Filings" link and the "Companies & Other Filers" link, enter "Dell Computer," and search for SEC filings made by Dell. Find the most recent 10Q and 10K and download the forms. Look on the balance sheet to find the book value of debt and the book value of equity. If you look further down the report, you should find a section titled either "Long-Term Debt" or "Long-Term Debt and Interest Rate Risk Management" that will list a breakdown of Dell's long-term debt.

2. To estimate the cost of equity for Dell, go to finance.yahoo.com and enter the ticker symbol "DELL." Follow the various links to find answers to the following questions: What is the most recent stock price listed for Dell? What is the market value of equity, or market capitalization? How many shares of stock does Dell have outstanding? What is the beta for Dell? Now go back to finance.yahoo.com and follow the "Bonds" link. What is the yield on 3-month Treasury bills? Using a 7 percent market risk premium, what is the cost of equity for Dell using the CAPM?

3. Go to www.reuters.com and find the list of competitors in the industry. Find the beta for each of these competitors, and then calculate the industry average beta. Using the industry average beta, what is the cost of equity? Does it matter if you use the beta for Dell or the beta for the industry in this case?

4. You now need to calculate the cost of debt for Dell. Go to cxa.marketwatch.com/finra/BondCenter/Default.aspx, enter Dell as the company, and find the yield to maturity for each of Dell's bonds. What is the weighted average cost of debt for Dell using the book value weights and the market value weights? Does it make a difference in this case if you use book value weights or market value weights?

5. You now have all the necessary information to calculate the weighted average cost of capital for Dell. Calculate the weighted average cost of capital for Dell using book value weights and market value weights assuming Dell has a 35 percent marginal tax rate. Which cost of capital number is more relevant?

6. You used Dell as a representative company to estimate the cost of capital for GCI. What are some of the potential problems with this approach in this situation? What improvements might you suggest?