CHAPTER 13

# Risk, Cost of Capital, and Valuation

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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 Vision 2020, 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 cost of capital at 9 percent and earned a company record premium of €3.9 billion above its cost of capital. In 2011, the company pegged its WACC at 11 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.

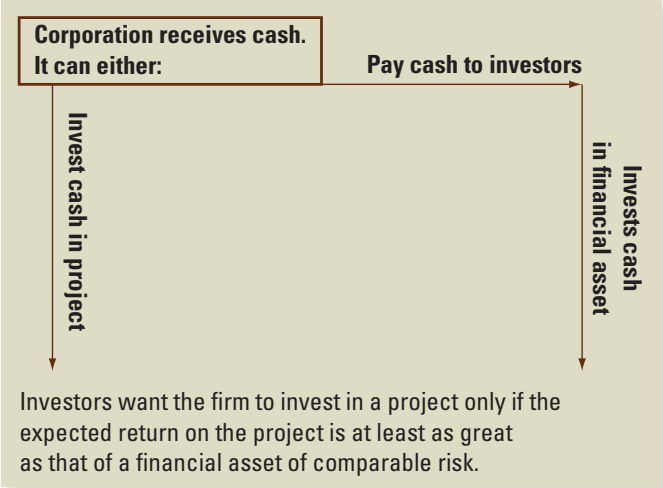
The goal of this chapter is to determine the rate at which cash flows of risky projects and firms are to be discounted. Projects and firms are financed with equity, debt, and other sources, and we must estimate the cost of each of these sources in order to determine the appropriate discount rate. We 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 ($R_{WACC}$ or, more simply, WACC), which is used to discount cash flows. We calculate the WACC for a real-world company, Eastman Chemical Co. We show how both firms and projects can be valued using WACC. Finally, we introduce flotation costs.

## 13.1 The Cost of Capital

Whenever a firm has extra cash, it can take one of two actions. It can pay out the cash directly to its investors. Alternatively, the firm can invest the extra cash in a project, paying out the future cash flows of the project. Which action would the investors prefer? If investors can reinvest the cash in a financial asset (a stock or bond) with the same risk as that of the project, the investors 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 13.1. 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.**

**Figure 13.1**
**Choices of a Firm with Extra Cash**




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. 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.

## 13.2 Estimating the Cost of Equity Capital with the CAPM

We start with the cost of equity capital, which is the required return on the stockholders' investment in the firm. 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:

$$R_S = R_F + \beta \times (R_M - R_F) \qquad (13.1)$$

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 13.1 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, $\beta$.

**EXAMPLE 13.1**

**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:

$$\begin{aligned} R_S &= 5\% + (8.4\% \times 1.3) \\ &= 5\% + 10.92\% \\ &= 15.92\% \end{aligned}$$

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.

**EXAMPLE 13.2**

**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 13.1. 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 $\beta$ of 1.21, it is the return they expect on Alpha Air Freight's stock.

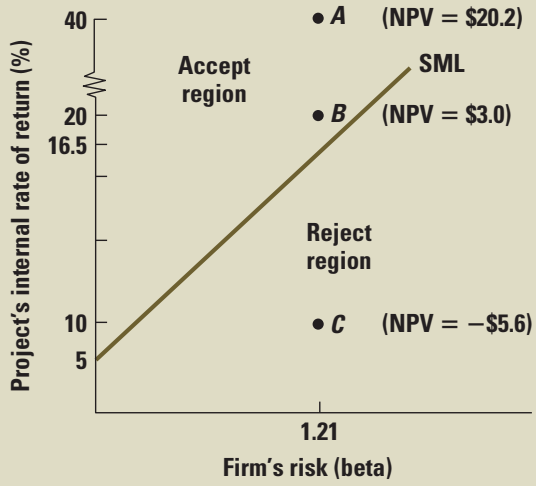
[1]John R. Graham and Campbell R. Harvey, "The Theory and Practice of Corporate Finance: Evidence from the Field," *Journal of Financial Economics* (2001), report in their Table 3 that 73.49 percent of the companies in their sample use the CAPM for capital budgeting.

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 13.2.

**Figure 13.2** **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 above 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 short-term rate would be a good place to start. The one-year Treasury bill rate is used frequently and we will adopt this convention. The problem is that some projects have long lives, so the average one-year rate anticipated over the life of the project, rather than today's one-year rate, is preferred.[2]

How can we estimate this expected one-year rate? The anticipated average one-year rate can be estimated from the term structure. Over the period from 1926 to 2011, the average return on 20-year Treasury bonds was 6.1 percent, and the average return on one-year Treasury bills was 3.6 percent. Thus, the term premium, as it is called, was $6.1 - 3.6 = 2.5\%$. This positive term premium is not surprising, since we know that the term structure of interest rates typically slopes upward, reflecting interest rate risk. Suppose the yield on a 20-year Treasury bond is about 3.5 percent. This yield should reflect both the average one-year interest rate over the next 20 years and the term premium. Thus, one can argue that the average one-year interest rate expected over the next 20 years is $3.5\% - 2.5\% = 1.0\%$.

## MARKET RISK PREMIUM

**Method 1: Using Historical Data** In Chapter 10, we settled on an estimate of 7 percent for the market risk premium, though this number should not be interpreted as definitive.

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

$$1.0\% + 1.5 \times 7\% = 11.5\%$$

**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 9, we pointed out that the price of a share of stock can be thought of as 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:

$$P = \frac{\text{Div}}{R_S - g}$$

[2]Another approach is to select a U.S. Treasury security whose maturity matches the maturity of a particular project. The match would need to be exactly correct because while U.S. Treasury securities are probably close to default-free, they have interest rate risk (and so longer term U.S. Treasury securities are not necessarily risk free). Our approach attempts to separate the default risk and interest rate risk elements. In practice both approaches can be used.

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

$$R_S = \frac{\text{Div}}{P} + g$$

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

Just as this formula can be used to estimate the total expected return on a stock, it can be used to estimate the total expected 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 and Poor's (S&P) 500 Index was about 2.1 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 2.1 percent, the expected return on the market becomes 2.1% + 6% = 8.1%. Given our anticipated average one-year yield on Treasury bills of 1.0 percent, the market risk premium would be 8.1% − 1.0% = 7.1%, almost identical to the 7 percent provided by method 1.

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

$$1.0\% + (1.5 \times 7.1\%) = 11.65\%$$

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.

Academics have, nevertheless, long preferred the historical estimated market risk premium for its objectivity. By contrast, estimation of future dividend growth in the DDM seems more subjective. However, the subjective nature of the DDM approach is not meant as a criticism. Proponents of using the DDM 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.[3] The expression, "You can't squeeze blood out of a turnip," applies here.

## 13.3 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:

$$\text{Beta of security } i = \frac{\text{Cov}(R_i, R_M)}{\text{Var}(R_M)} = \frac{\sigma_{i,M}}{\sigma_M^2} \qquad \textbf{(13.2)}$$

[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).

## 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.

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.

## REAL-WORLD BETAS

It is instructive to see how betas are determined for actual real-world companies. Figure 13.3 plots monthly returns for four large firms against monthly returns on the S&P 500 Index. Using a standard regression technique, we fit a straight line through the 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 table, 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 our figure, 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 Procter & Gamble has relatively low risk and Bank of America 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?

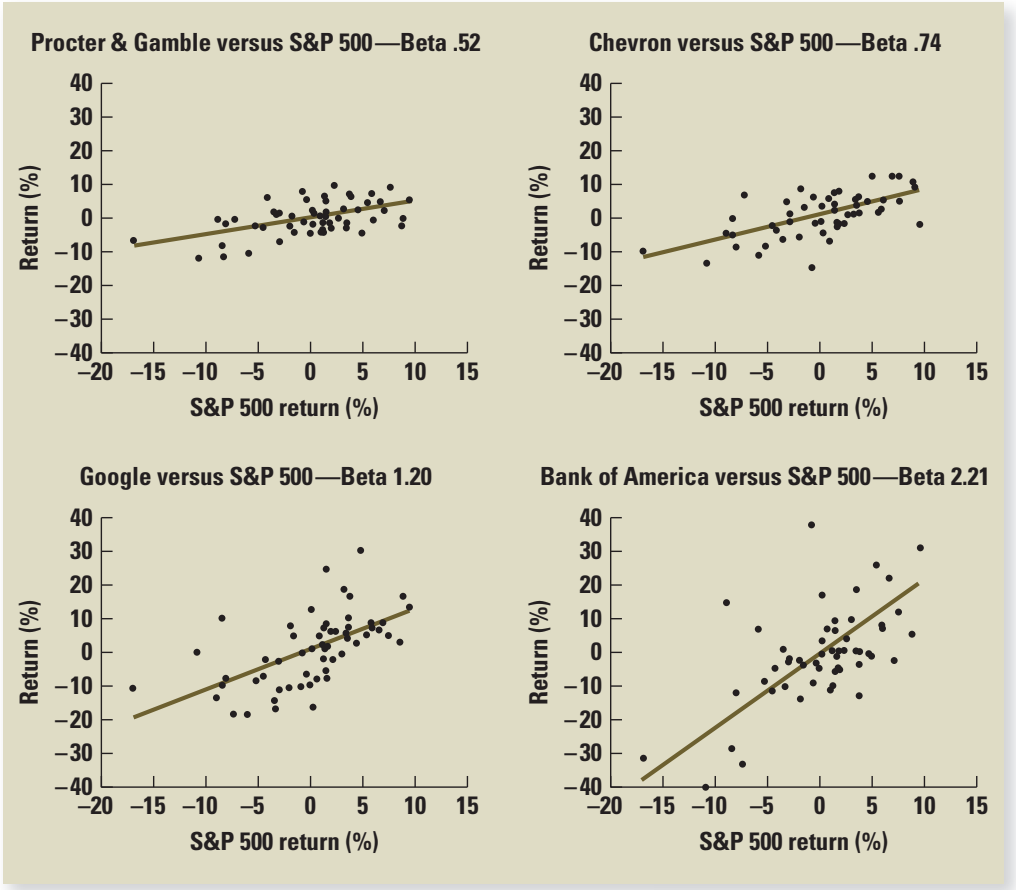



**Figure 13.3**
**Plots of Five Years of Monthly Returns (2006–2010) on Four Individual Securities against Five Years of Monthly Returns on the Standard & Poor's (S&P) 500 Index**

Take the case of Microsoft, which has remained in the same industry for many decades. Figure 13.4 plots the returns on Microsoft and the returns on the S&P 500 for four successive five-year periods. As can be seen from the figure, Microsoft's beta varies from period to period. However, this movement in beta is probably nothing more than random variation.[4] Thus, for practical purposes, Microsoft's beta has been approximately constant over the two decades covered in the figure. Although Microsoft is just one company, most analysts argue that betas are generally stable for firms remaining in the same industry.

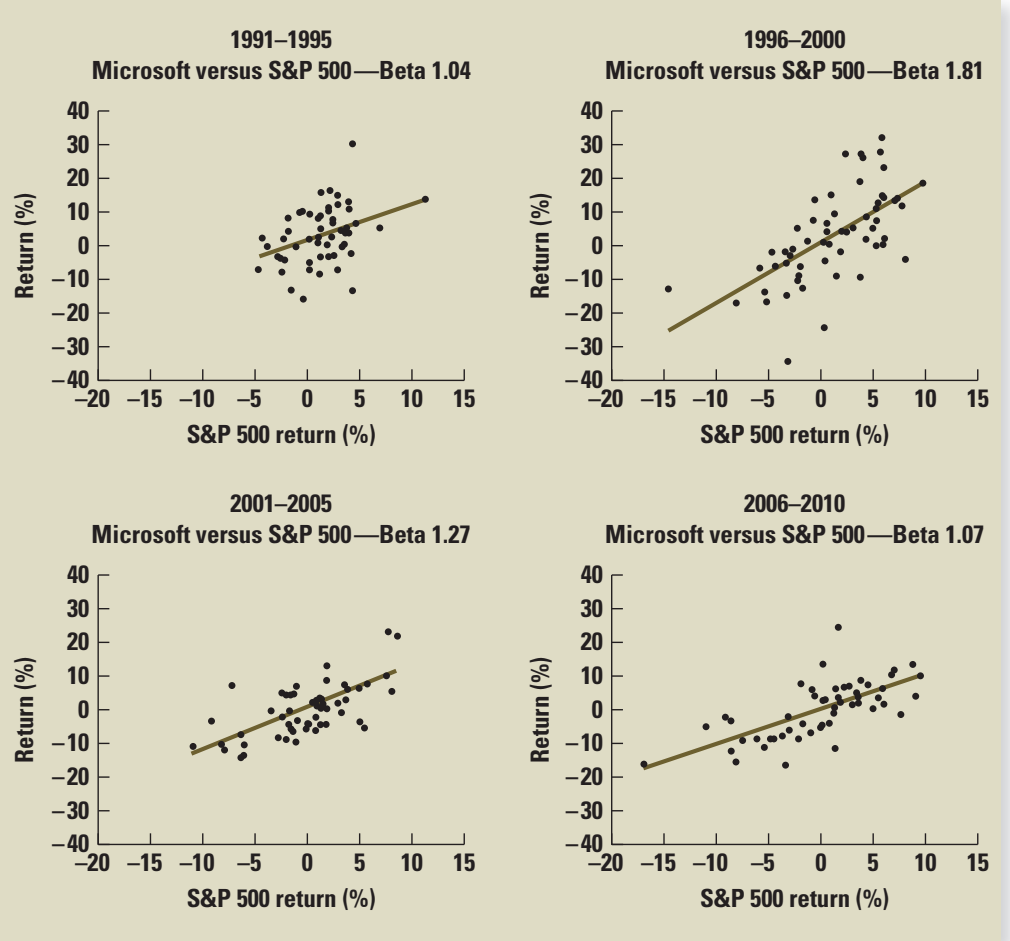
However, this is not to say that, as long as a firm stays in the same industry, its beta will *never* change. Changes in product line, changes in technology, or changes in the market may affect a firm's beta. Furthermore, as we will show in a later section, an increase in the leverage of a firm (i.e., 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 commonsensical to you. However, it is frequently argued that people can better estimate

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

**Figure 13.4**
**Plots of Monthly Returns on Microsoft Corporation against returns on the Standard & Poor's 500 Index for Four Consecutive Five-Year Periods**




a firm's beta by involving the whole industry. Consider Table 13.1, which shows the betas of some prominent firms in the software industry. The average beta across all of the firms in the table is .97. Imagine a financial executive at Automatic Data Processing 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 .70. 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 Automatic Data Processing may prefer the average industry beta of .97 as the estimate of his or her own firm's beta.[5]

Assuming a risk-free rate of 1.0 percent and a risk premium of 7 percent, Automatic Data Processing might estimate its cost of equity capital as:

$$1.0\% + .7 \times 7\% = 5.9\%$$

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

$$1.0\% + .97 \times 7\% = 7.79\%$$

The difference is substantial here, presenting a difficult choice for a financial executive at Automatic Data Processing.

[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.

**Table 13.1**
**Betas for Firms in the Computer Software Industry**

| Company | Beta |
|---|---|
| Microsoft | 1.00 |
| Apple, Inc. | 1.22 |
| Automatic Data Processing | .70 |
| Oracle Corp. | 1.09 |
| Computer Sciences | 1.15 |
| CA, Inc. | .97 |
| Fiserv, Inc. | 1.07 |
| Accenture, Ltd. | .79 |
| Symantec Corp. | .91 |
| Paychex, Inc. | .84 |
| Equally weighted portfolio | .97 |

SOURCE: www.reuters.com

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.

## 13.4 Determinants of Beta

The regression analysis approach in Section 13.3 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

[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.

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 7. 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:

$$\beta_{\text{Portfolio}} = \beta_{\text{Asset}} = \frac{S}{B+S} \times \beta_{\text{Equity}} + \frac{B}{B+S} \times \beta_{\text{Debt}} \tag{13.3}$$

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:

$$\beta_{\text{Asset}} = \frac{S}{B+S} \times \beta_{\text{Equity}} \tag{13.4}$$

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

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

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 13.3 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 13.4 to arrive at the asset beta. (Of course, the two betas are the same for an all-equity firm.)

**EXAMPLE 13.3**

**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:

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

$$1.2 = .8\left(1 + \frac{1}{2}\right)$$

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.

## 13.5 The Dividend Discount Model Approach

In Section 13.2, 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 13.2 on the DDM led to the following formula:

$$R_S = \frac{\text{Div}}{P} + g$$

where $P$ is the price per share of a stock, Div is the dividend per share to be received next year, $R_S$ is the discount rate, and $g$ is the expected annual growth rate in dividends per share. The equation tells us that the discount rate on a stock is equal to the sum of

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

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

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

the stock's dividend yield (=Div/$P$) and its expected growth rate of dividends. Thus, in order to apply the DDM to a particular stock, we must estimate both the dividend yield and the expected 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 expected 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 9, 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 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 7.5 percent for Eastman Chemical Co. The company's dividend yield was 1.04 percent, implying an expected rate of return, and therefore a cost of equity capital, of 1.04 + 7.5 = 8.54% 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? The CAPM has two primary advantages. First, it explicitly adjusts for risk, and second, it is applicable to companies that pay no dividends or whose dividend growth is difficult to estimate. The primary advantage of the DDM is its simplicity. Unfortunately, the DDM is only applicable to firms that pay steady dividends; it is completely useless if companies do not. Another drawback of the DDM is that it does not explicitly consider risk.

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

[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.

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, and can be a useful check on the CAPM estimates.

## 13.6 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.

**EXAMPLE 13.4**

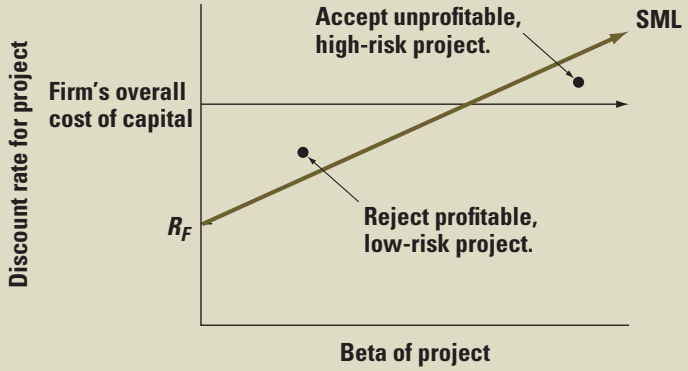
**Project Risk** D. D. Ronnelley Co., a publishing firm, may accept a project in computer software. Noting that computer software companies have high betas, the publishing firm views the software venture as more risky than the rest of its business. It should discount the project at a rate commensurate 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 13.5.

(*continued*)

[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.

[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.

**Figure 13.5** **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.

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, General Electric, 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.

## 13.7 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. In general, the cost of debt is easier to determine. For bonds with a small risk of defaulting, the current yield to maturity is a good estimate of investor expected returns and 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 is the cost of debt. 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:

$$\text{Aftertax cost of debt} = (1 - \text{Tax rate}) \times \text{Borrowing rate}$$
$$6\% = (1 - .40) \times 10\%$$

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.

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 = $C/R_P$, where PV is the present value, or price, $C$ is the cash to be received each year, and $R_P$ is the yield, or rate of return. Rearranging, we have:

$$R_P = C/\text{PV}$$

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.

## 13.8 The Weighted Average Cost of Capital

Sections 13.1 and 13.2 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:

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

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

Assembling these results, we get the average cost of capital (after tax) for the firm:[11]

$$\text{Average cost of capital} = \left(\frac{S}{S+B}\right) \times R_S + \left(\frac{B}{S+B}\right) \times R_B \times (1 - t_C) \qquad (13.5)$$

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.

**EXAMPLE 13.5**

**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

(*continued*)

[11] For simplicity, Equation 13.5 ignores preferred stock financing. With the addition of preferred stock, the formula becomes:

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

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

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 13.5, 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:

$$\begin{aligned} R_S &= R_F + \beta \times [R_M - R_F] \\ &= 1\% + 1.41 \times 9.5\% \\ &= 14.40\% \end{aligned}$$

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:

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

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.

## 13.9 Valuation with $R_{WACC}$

Now we are in a position to use the weighted average cost of capital, $R_{WACC}$, to value both projects and entire firms. Our interpretation of $R_{WACC}$ is that it is the overall expected return the firm must earn on its existing assets to maintain its value. The $R_{WACC}$ reflects the risk and the capital structure of the firm's existing assets. As a result the $R_{WACC}$ is an appropriate discount rate for the firm or for a project that is a replica of the firm.

### PROJECT EVALUATION AND THE $R_{WACC}$

When valuing a project we start by determining the correct discount rate and use discounted cash flow to determine NPV.

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 $R_{\text{WACC}}$ will then be:

$$\begin{aligned} R_{\text{WACC}} &= \left(\frac{S}{S+B}\right) \times R_S + \left(\frac{B}{S+B}\right) \times R_B \times (1 - t_C) \\ &= .625 \times 10\% + .375 \times 5.15\% \times .66 = 7.52\% \end{aligned}$$

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 $R_{\text{WACC}}$, we have:

$$\begin{aligned} \text{NPV} &= -\$60 + \frac{\$12}{(1 + R_{\text{WACC}})} + \cdots + \frac{\$12}{(1 + R_{\text{WACC}})^6} \\ &= -\$60 + \$12 \times \frac{\left[1 - \left(\frac{1}{1.0752}\right)^6\right]}{.0752} \\ &= -\$60 + (12 \times 4.69) \\ &= -\$3.71 \end{aligned}$$

Should the firm take on the warehouse renovation? The project has a negative NPV using the firm's $R_{\text{WACC}}$. 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.

Of course, we are assuming that the project is in the same risk class as the firm and that the project is an integral part of the overall business.

## FIRM VALUATION WITH THE $R_{\text{WACC}}$

When valuing a complete business enterprise our approach is the same as the one used for individual capital projects like the warehouse renovation, except that we use a horizon, and this complicates the calculations. Specifically, we use the firm's weighted average cost of capital as our discount rate, and we set up the usual discounted cash flow model by forecasting the firm's entire net cash flow (sometimes called distributable cash flow, free cash flow, or total cash flow of the firm) up to a horizon along with a terminal value of the firm:

$$\text{PV}_0 = \frac{CF_1}{1 + R_{\text{WACC}}} + \frac{CF_2}{(1 + R_{\text{WACC}})^2} + \frac{CF_3}{(1 + R_{\text{WACC}})^3} + \cdots + \frac{CF_T + TV_T}{(1 + R_{\text{WACC}})^T}$$

Consistent with the differential growth version of the dividend discount model, the terminal value ($TV$)[12] is estimated by assuming a constant perpetual growth rate for cash flows beyond the horizon, $T$, so that:

$$TV_T = \frac{CF_{T+1}}{R_{\text{WACC}} - g_{CF}} = \frac{CF_T(1 + g_{CF})}{R_{\text{WACC}} - g_{CF}}$$

[12]The terminal date is often referred to as the horizon. In general, we choose a horizon whenever we can assume cash flow grows at a constant rate perpetually thereafter. By using the word terminal, we do not rule out the firm continuing to exist. Instead, we are attempting to simplify the cash flow estimation process.

where $CF$ is the net cash flows and is equal to earnings before interest and taxes (EBIT), minus taxes, minus capital spending, minus increases in net working capital plus deprecation.[13] $g_{CF}$ is the growth rate of cash flow beyond $T$, and $R_{WACC}$ is the weighted average cost of capital.

Consider the Good Food Corporation, a public company headquartered in Barstow, California, that is currently a leading global food service retailer. It operates about 10,000 restaurants in 100 countries. Good Food serves a value-based menu focused on hamburgers and french fries. The company has $4 billion in market valued debt and $2 billion in market valued common stock. Its tax rate is 20 percent. Good Food has estimated its cost of debt as 5 percent and its cost of equity as 10 percent. Its weighted average cost of capital is equal to:

| Financial Component | Market Values | Weights | Cost of Capital | Weighted Average |
|---|---|---|---|---|
| Debt | $4 billion | 2/3 | 5%(1−.2) = 4% | 2/3 × 4% |
| Equity | $2 billion | 1/3 | 10% | 1/3 × 10% |
| | $6 billion | | | 6% = the weighted average cost of capital |

Good Food is seeking to grow by acquisition and the investment bankers of Good Food have identified a potential acquisition candidate, Happy Meals, Inc. Happy Meals is currently a private firm with no publicly tradable common stock but has the same product mix as Good Food and is a direct competitor to Good Food in many markets. It operates about 4,000 restaurants mostly in North America and Europe. Happy Meals has $1,318.8 million of debt outstanding with its market value the same as the book value.[14] It has 12.5 million shares outstanding. Since Happy Meals is a private firm, we have no stock market price to rely on for our valuation. Happy Meals expects its EBIT to grow 10 percent a year for the next five years. Increases in net working capital and capital spending are both expected to be 24 percent of EBIT. Depreciation will be 8 percent of EBIT. The perpetual growth rate in cash flow after five years is estimated to be 2 percent.

If Good Food acquires Happy Meals, Good Food analysts estimate the net cash flows from Happy Meals (in $ millions) would be (rounding to one decimal):

| Year | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Earnings before interest and taxes (EBIT) | 150 | 165 | 181.5 | 199.7 | 219.6 |
| − Taxes (20%) | 30 | 33 | 36.3 | 39.9 | 43.9 |
| = Earnings after taxes | 120 | 132 | 145.2 | 159.8 | 175.7 |
| + Depreciation | 12 | 13.2 | 14.5 | 16 | 17.6 |
| − Capital spending | 36 | 39.6 | 43.6 | 47.9 | 52.7 |
| − Increases in net working capital | 36 | 39.6 | 43.6 | 47.9 | 52.7 |
| = Net cash flows ($CF$) | 60 | 66 | 72.6 | 80 | 87.8 |

[13]This definition of cash flow is the same one we used to determine the NPV of capital investments in Chapter 6.

[14]Sometimes analysts refer to a firm's net debt which is the market value of debt minus excess cash. Neither Good Food or Happy Meals has excess cash.

We start our calculations by computing a terminal value of Happy Meals as:

$$TV_5 = \frac{\$87.8 \times 1.02}{.06 - .02} = \$2{,}238.9$$

Next, we compute the present value of Happy Meals to be:

$$PV_0 = \frac{\$60}{1.06} + \frac{\$66}{(1.06)^2} + \frac{\$72.6}{(1.06)^3} + \frac{\$79.9}{(1.06)^4} + \frac{\$87.8}{(1.06)^5} + \frac{\$2{,}238.9}{(1.06)^5} = \$1{,}978.2$$

The present value of net cash flows in Years 1 to 5 is \$305.2, and the present value of the terminal value is:

$$\$2{,}238.9 \times \left(\frac{1}{1.06}\right)^5 = \$1{,}673.0$$

so the total value of the company is \$305.2 + \$1,673.0 = \$1,978.2.

To find the value of equity, we subtract the value of debt which gives us \$1,978.2 − \$1,318.8 = \$659.4. To find the equity value per share, we divide the value of equity by the number of shares outstanding: \$659.4/12.5 = \$52.8. Good Food will find Happy Meals an attractive acquisition candidate for payments of less than \$52.8 per share (the less the better).

In doing our valuation of Happy Meals, Inc., it is important to remember that we have assumed that Happy Meals is a pure play for Good Food. Our weighted average cost of capital method only works if Happy Meals has the same business risks as Good Food and the debt-to-equity ratio will remain the same.

The above calculations assume a growing perpetuity after Year 5 (i.e., the horizon). However, we pointed out in Chapter 3 and Chapter 9 that firms as a whole are often valued by multiples. The most common multiple for overall firm valuation is the enterprise value to the EBITDA multiple (i.e., EV/EBITDA). For example, the analysts at Good Food might estimate the terminal value of Happy Meals via an EV/EBITDA multiple, rather than a growing perpetuity. To see how this might work, suppose the EV/EBITDA multiple for comparable firms in the food service industry is 10. The EBITDA for Happy Meals in Year 5 will be equal to EBIT + depreciation or \$237.2 (=\$219.6 + \$17.6). Using the EV/EBITDA multiple of 10, the value of Happy Meals in Year 5 can be estimated as \$2,372.0. The present value of Happy Meals using the EV/EBITDA multiple for terminal value would be:

$$PV_0 = \frac{\$60}{1.06} + \frac{\$66}{(1.06)^2} + \frac{\$72.6}{(1.06)^3} + \frac{\$79.9}{(1.06)^4} + \frac{\$87.8}{(1.06)^5} + \frac{\$2{,}372}{(1.06)^5} = \$2{,}077.7$$

The value of the equity of Happy Meals can be estimated as:

$$\text{PV(of entire firm) less debt} = \$2{,}077.7 - \$1{,}318.8 = \$758.9$$

With 12.5 million shares outstanding, the value of a share of equity would be:

$$\$758.9/12.5 = \$60.7$$

Now we have two estimates of the value of a share of equity in Happy Meals. The different estimates reflect the different ways of calculating terminal value. Using the constant growth discounted cash flow method for terminal value our estimate of the equity value per share of Happy Meals is \$52.8 and using the EV/EBITDA comparable firm method our estimate is \$60.7. As mentioned in Chapter 9, there is no

perfect method. If the comparable firms were all identical to Happy Meals, perhaps the EV/EBITDA method would be best. Unfortunately firms are not identical. On the other hand, if we were very sure of the terminal date and the growth in subsequent cash flows, perhaps the constant growth method would be best. Both methods are used.

## 13.10 Estimating Eastman Chemical's Cost of Capital

**ExcelMaster coverage online**

This section introduces the Hyperlink function.

In our previous sections, we calculated the cost of capital in examples. We will now calculate the cost of capital for a 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 www.reuters.com (ticker: EMN). In October 2011, the website reported the market capitalization of EMN's equity, which is share price times number of shares outstanding, as $5,259.42 million. To estimate Eastman's cost of equity, we will assume a market risk premium of 7 percent, similar to what we calculated in Chapter 11. Eastman's beta on Reuters is 1.88.

In Section 13.2, we estimated the average future riskless rate as the current 20-year Treasury bond yield minus the historical difference between the yield on the 20-year Treasury bond and the yield on the one-year Treasury bill. Since the yield on a Treasury bond was recently 3.5 percent and the historical yield difference between long- and short-term Treasury bonds was 2.5 percent, our estimate of the average riskless rate in the future is 3.5 − 2.5 = 1%.

Using Eastman's beta in the CAPM to estimate the cost of equity,[15] we find:

$$R_S = .01 + (1.88 \times .07) = .1416 \text{ or } 14.16\%$$

**Eastman's Cost of Debt** Eastman has eight bond issues that account for essentially all of its debt. To calculate the cost of debt, we will have to combine these eight 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

[15]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.

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 | $150 | 103.875 | 1.33% |
| 3.00 | 2015 | 250 | 101.408 | 2.64 |
| 6.30 | 2018 | 177 | 107.500 | 5.02 |
| 5.50 | 2019 | 250 | 111.860 | 3.78 |
| 4.50 | 2021 | 250 | 103.677 | 4.02 |
| 7.25 | 2024 | 243 | 114.840 | 5.56 |
| 7.625 | 2024 | 54 | 122.300 | 5.20 |
| 7.60 | 2027 | 222 | 113.909 | 6.18 |

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% | $ 150 | 9.40% | $ 155.81 | 8.97% | 1.33% | .12% | .12% |
| 3.00 | 250 | 15.66 | 253.52 | 14.60 | 2.64 | .41 | .39 |
| 6.30 | 177 | 11.09 | 190.28 | 10.96 | 5.02 | .56 | .55 |
| 5.50 | 250 | 15.66 | 279.65 | 16.10 | 3.78 | .59 | .61 |
| 4.50 | 250 | 15.66 | 259.19 | 14.93 | 4.02 | .63 | .60 |
| 7.25 | 243 | 15.23 | 279.06 | 16.07 | 5.56 | .85 | .89 |
| 7.625 | 54 | 3.38 | 66.04 | 3.80 | 5.20 | .18 | .20 |
| 7.60 | 222 | 13.91 | 252.88 | 14.56 | 6.18 | .86 | .90 |
| Total | $1,596 | 100.00% | $1,736.43 | 100.00% | | 4.20% | 4.25% |

As these calculations show, Eastman's cost of debt is 4.2 percent on a book value basis and 4.25 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.

**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 $1.736 billion and $5.259 billion, respectively. The total value of the firm is $6.995 billion, implying that the debt

and equity percentages are 1.736/6.995 = .248 and 5.259/6.995 = .752, respectively. Assuming a tax rate of 35 percent, Eastman's WACC is:

$$R_{WACC} = .248 \times .0425 \times (1 - .35) + .752 \times .1416 = .1133, \text{ or } 11.33\%$$

## 13.11 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:

$$\begin{aligned} f_o &= (S/V) \times f_S + (B/V) \times f_B \\ &= 60\% \times .10 + 40\% \times .05 \\ &= 8\% \end{aligned} \qquad (13.6)$$

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.

**EXAMPLE 13.6**

**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, $f_o$:

$$\begin{aligned} f_o &= S/V \times f_S + B/V \times f_B \\ &= 80\% \times .20 + 20\% \times .06 \\ &= 17.2\% \end{aligned}$$

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:

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

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

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

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:

$$\begin{aligned} f_o &= S/V \times f_S + B/V \times f_B \\ &= .50 \times 10\% + .50 \times 2\% \\ &= 6\% \end{aligned}$$

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 assumed 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:

$$\begin{aligned} f_o &= S/V \times f_S + B/V \times f_B \\ &= .50 \times 0\% + .50 \times 2\% \\ &= 1\% \end{aligned}$$

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

◀ To test your mastery of this material, take a quiz at mhhe.com/rwj

## 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?