

## APPENDIX

## 9A

## USING THE CAPM TO ESTIMATE THE RISK-ADJUSTED COST OF CAPITAL

As an alternative to the subjective approach, firms can use the CAPM to directly estimate the cost of capital for specific projects or divisions. To begin, recall from Chapter 5 that the Security Market Line equation expresses the risk/return relationship as follows:

$$k_s = k_{RF} + (k_M - k_{RF})b_i.$$

As an example, consider the case of Erie Steel Company, an integrated steel producer operating in the Great Lakes region. For simplicity, assume that Erie uses only equity capital, so its cost of equity is also its corporate cost of capital, or WACC. Erie's beta =  $b = 1.1$ ;  $k_{RF} = 8\%$ ; and  $k_M = 12\%$ . Thus, Erie's cost of equity and hence its WACC is 12.4 percent:

$$\begin{aligned} k_s = \text{WACC} &= 8\% + (12\% - 8\%)1.1 \\ &= 8\% + (4\%)1.1 \\ &= 12.4\%. \end{aligned}$$

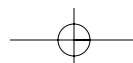
This suggests that investors should be willing to give Erie money to invest in average-risk projects if the company expects to earn 12.4 percent or more on this money. Here again, by average risk we mean projects having risk similar to the firm's existing assets. *Therefore, as a first approximation, Erie should invest in capital projects if and only if those projects have an expected return of 12.4 percent or more.*<sup>1</sup> Erie should use 12.4 percent as its hurdle rate for an average-risk project.

Suppose, however, that taking on a particular project would cause a change in Erie's beta coefficient, which, in turn, would change the company's cost of equity. For example, suppose Erie is considering the construction of a fleet of barges to haul iron ore, and barge operations have betas of 1.5 rather than 1.1. Since the firm itself may be regarded as a "portfolio of assets," and since the beta of any portfolio is a weighted average of the betas of its individual assets, taking on the barge project would cause the overall corporate beta to rise to somewhere between the original beta of 1.1 and the barge project's beta of 1.5. The exact value of the new beta would depend on the relative size of the investment in barge operations versus Erie's other assets. If 80 percent of Erie's total funds ended up in basic steel operations with a beta of 1.1 and 20 percent in barge operations with a beta of 1.5, the new corporate beta would be 1.18:

$$\begin{aligned} \text{New beta} &= 0.8(1.1) + 0.2(1.5) \\ &= 1.18. \end{aligned}$$

This increase in Erie's beta coefficient would cause its stock price to decline *unless the increased beta were offset by a higher expected rate of return*. Specifically, taking on the

<sup>1</sup> Note that we assume that the firm uses only equity capital. If debt were used, the cost of capital must be a weighted average of the costs of debt and equity.



new project would cause the overall corporate cost of capital to rise from the original 12.4 percent to 12.72 percent:

$$\begin{aligned}k_s &= 8\% + (4\%)1.18 \\ &= 12.72\%.\end{aligned}$$

Therefore, to keep the barge investment from lowering the value of the firm, Erie's overall expected rate of return must rise from 12.4 to 12.72 percent.

If investments in basic steel must earn 12.4 percent, how much must Erie expect to earn on the barge investment to cause the new overall expected rate of return to equal 12.72 percent? We know that if Erie undertakes the barge investment, it will have 80 percent of its assets invested in basic steel projects earning 12.4 percent and 20 percent in barge operations earning "X" percent, and the average required rate of return will be 12.72 percent. Therefore,

$$\begin{aligned}0.8(12.4\%) + 0.2X &= 12.72\% \\ 0.2X &= 2.8\% \\ X &= 14\%.\end{aligned}$$

Since  $X = 14\%$ , we see that the barge project must have an expected return of 14 percent if the corporation is to earn its new cost of capital.

In summary, if Erie takes on the barge project, its corporate beta will rise from 1.1 to 1.18, its cost of capital will rise from 12.4 to 12.72 percent, and the barge investment must earn 14 percent if the company is to earn its new overall cost of capital.

This line of reasoning leads to the conclusion that if the beta coefficient for each project,  $b_p$ , could be determined, then a **project cost of capital,  $k_p$** , for each individual project could be found as follows:<sup>2</sup>

$$k_p = k_{RF} + (k_M - k_{RF})b_p.$$

Thus, for basic steel projects with  $b = 1.1$ , Erie should use 12.4 percent as the cost of capital. The barge project, with  $b = 1.5$ , should be evaluated at a 14 percent cost of capital:

$$\begin{aligned}k_{\text{Barge}} &= 8\% + (4\%)1.5 \\ &= 8\% + 6\% \\ &= 14\%.\end{aligned}$$

On the other hand, a low-risk project, such as a new distribution center with a beta of only 0.5, would have a cost of capital of 10 percent:

$$\begin{aligned}k_{\text{Center}} &= 8\% + (4\%)0.5 \\ &= 10\%.\end{aligned}$$

Figure 9A-1 can be used to illustrate the CAPM approach for Erie Steel. Note the following points:

1. The SML is the same Security Market Line that we developed in Chapter 5. It shows how investors are willing to make trade-offs between risk as measured

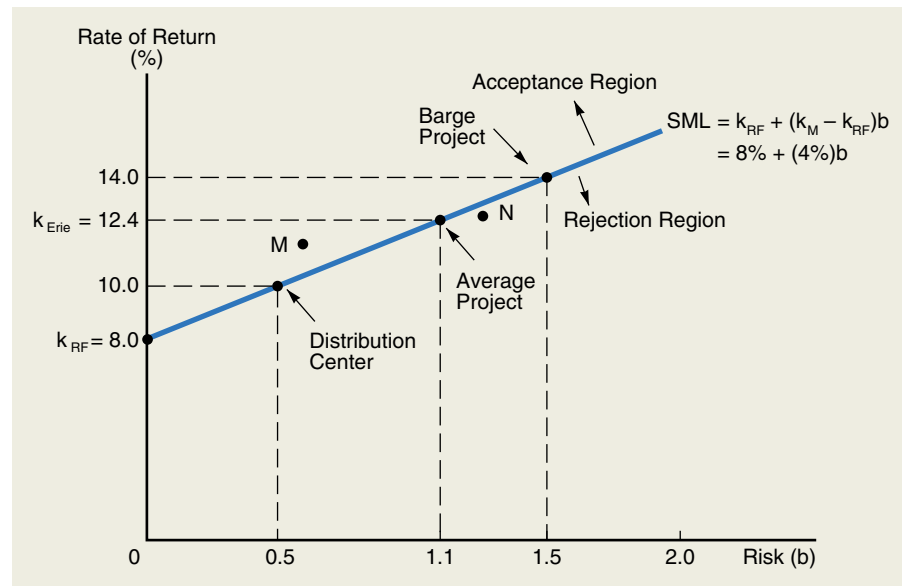
<sup>2</sup> Note that the term  $k_p$  can also stand for the cost of preferred stock. Keep this dual usage of the term in mind to avoid confusion.

### Project Cost of Capital, $k_p$

The risk-adjusted cost of capital for an individual project.

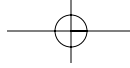
FIGURE 9A-1

## Using the Security Market Line Concept in Capital Budgeting



by beta and expected returns. The higher the beta risk, the higher the rate of return needed to compensate investors for bearing this risk.

- Erie Steel initially has a beta of 1.1, so its required rate of return on average-risk investments is 12.4 percent.
- High-risk investments such as the barge line require higher rates of return, whereas low-risk investments such as the distribution center require lower rates. If Erie concentrates its new investments in either high- or low-risk projects as opposed to average-risk projects, its corporate beta will rise or fall from the current value of 1.1. Consequently, Erie's required rate of return on common stock would change from its current value of 12.4 percent.
- If the expected rate of return on a given capital project lies *above* the SML, then the expected rate of return on the project is more than enough to compensate for its risk, and the project should be accepted. Conversely, if the project's rate of return lies *below* the SML, it should be rejected. Thus, Project M in Figure 9A-1 is acceptable, whereas Project N should be rejected. N has a higher expected return than M, but the differential is not enough to offset its higher risk.
- For simplicity, the Erie Steel illustration is based on the assumption that the company used no debt financing, which allows us to use the SML to plot the company's cost of capital. The basic concepts presented in the Erie illustration also hold for companies that use debt financing. As we discussed in previous chapters, the discount rate applied in capital budgeting is the firm's weighted average cost of capital. When debt financing is used, the project's cost of equity must be combined with the cost of debt to obtain the project's overall cost of capital.

**PROBLEM****9A-1**  
CAPM approach to risk  
adjustments

Goodtread Rubber Company has two divisions: the tire division, which manufactures tires for new autos, and the recap division, which manufactures recapping materials that are sold to independent tire recapping shops throughout the United States. Since auto manufacturing fluctuates with the general economy, the tire division's earnings contribution to Goodtread's stock price is highly correlated with returns on most other stocks. If the tire division were operated as a separate company, its beta coefficient would be about 1.50. The sales and profits of the recap division, on the other hand, tend to be countercyclical, because recap sales boom when people cannot afford to buy new tires. The recap division's beta is estimated to be 0.5. Approximately 75 percent of Goodtread's corporate assets are invested in the tire division and 25 percent are invested in the recap division.

Currently, the rate of interest on Treasury securities is 9 percent, and the expected rate of return on an average share of stock is 13 percent. Goodtread uses only common equity capital, so it has no debt outstanding.

- a. What is the new corporate beta?
- b. What is the required rate of return on Goodtread's stock?
- c. What is the cost of capital for projects in each division?

