Chapter 16

Additional Topics in International Capital Budgeting

*S*iemens, the German company known for its expertise in electrical engineering and electronics, has 277,000 employees outside of Germany. If its Brazilian subsidiary would like to expand its operations in anticipation of growth throughout Latin America, someone in German headquarters must decide whether the projected benefits outweigh the costs. Will the analysis be done in euros or Brazilian reals? Will it matter? This chapter addresses such questions.

International capital budgeting can be done in two basic ways: either by forecasting future foreign currency cash flows and then discounting them with a foreign currency discount rate or by converting the foreign currency cash flows into forecasts denominated in the domestic currency and then discounting them with a domestic currency discount rate. The two values should be the same when expressed in a common currency. However, that doesn't always happen in practice unless the two methods are used with the same implicit assumptions. The chapter considers an international capital budgeting case that demonstrates how easy it is to get different values with the two methods for discounting foreign currency cash flows and what assumptions are required to ensure that the methods are equivalent.

This chapter also discusses several important topics that extend and complement the basic international capital budgeting analysis presented in Chapter 15. In that chapter, we developed a framework for international capital budgeting using adjusted net present value (ANPV) analysis. In this chapter, we consider two alternative approaches. First, we discuss how to value a project using the weighted average cost of capital (WACC) approach to capital budgeting. Then, we examine the flow-to-equity (FTE) approach to capital budgeting, which is a third way of valuing projects. We discuss situations in which firms might prefer to use WACC or FTE, we explore the limitations of the different approaches, and we determine when a WACC or an FTE analysis is equivalent to an ANPV analysis.

It is well known that valuations often hinge on assumptions about terminal values. We examine what happens if we assume that current expansion of the firm and future competition drive the return on investment equal to the cost of capital into the indefinite future. How fast can the firm grow, and what is its terminal value?

We also examine how to value tax shields and subsidies on a firm's foreign currency loans, and we analyze a case in which a firm must choose between several different subsidized borrowing opportunities denominated in different currencies. The chapter discusses how the presence of outstanding debt can lead to conflicts of interest between the company's bondholders and stockholders. Finally, we briefly note that international differences in accounting standards must be taken into account when valuing corporations in different countries.

16.1 ALTERNATIVE APPROACHES TO CAPITAL BUDGETING

Chapter 15 reviewed some of the basic principles of international capital budgeting and project evaluation. We emphasized the importance of estimating the correct cash flows. We also advocated using the ANPV approach to value foreign projects.

The ANPV Approach

In the ANPV analysis, we first find the value of the unlevered, or all-equity, firm or project (which in this chapter we refer to as V_U) by discounting the expected value of the free cash flows. The discount rate, r_A, was the appropriate risk-adjusted required rate of return on the assets of the firm or the assets associated with the project. Then, we explored sources of additional value from the net present value of financial side effects and from the value of real options. Adding these various sources of value gives the value of the levered firm or project (which we call V_L).

Two Valuation Alternatives to ANPV

Capital budgeting is also done with the **weighted average cost of capital (WACC)** approach and the **flow-to-equity (FTE)** approach. When properly used, the three approaches are equivalent. We introduced the ANPV approach first because we like the way it identifies the economic sources of value. Nevertheless, the WACC approach is probably most widely used, and there are times when the FTE approach is most easily calculated. Hence, it is important to understand all three approaches, as well as their limitations.

The WACC approach to capital budgeting involves forecasting the all-equity free cash flows and then finding the value of the levered firm by discounting the all-equity free cash flows at an appropriate WACC. This is denoted r_{WACC}, and it is the weighted sum of the after-tax required rate of return on the firm's debt, r_D, and the required rate of return on the firm's equity, r_E. The market value of the equity is then found by subtracting the market value of the debt from the value of the levered firm.

The FTE approach finds the value of the equity directly by discounting the forecasts of the flows to equity holders at the appropriate risk-adjusted required rate of return on the equity, r_E. Then the value of the levered firm can be found by adding the value of the debt to the value of the equity.

The WACC Approach to Capital Budgeting

The WACC approach is a one-step method that works well for projects that have stable debt–equity ratios. An important point to remember about WACC is that if it is used for international projects, the weights should be specific to the international project and not to the overall firm. Unfortunately, some firms mistakenly use the same weighted average cost of capital (r_{WACC}) as the discount rate in all their capital budgeting decisions. To understand the logical foundations of WACC and its potential pitfalls, let's examine the derivation of r_{WACC} and how it can be used to value a firm.

WACC Without Taxes
Consider the value of a firm that has assets that are expected to yield cash flows of Y per year in perpetuity. If the riskiness of these cash flows dictates that they be discounted at r_A, we know from our ANPV analysis of Chapter 15 that the value of the unlevered firm is

$$V_U = \frac{Y}{(1 + r_A)} + \frac{Y}{(1 + r_A)^2} + \frac{Y}{(1 + r_A)^3} + \frac{Y}{(1 + r_A)^4} + \ldots = \frac{Y}{r_A} \qquad \textbf{(16.1)}$$

If the firm has no debt, the value of the equity, E, must be equal to the value of the unlevered firm, V_U.

Now, suppose that the firm issues some debt. Nobel Laureates Modigliani and Miller (1958, 1961) noted that in the absence of taxes, the presence of debt cannot change the value of the firm. Hence, without taxes, the value of the levered firm, V_L, equals the value of the unlevered firm. In other words, issuing debt does not create wealth—it merely transfers cash flows from the stockholders to the bondholders. If D represents the market value of the firm's debt, and if E_L represents the market value of the firm's levered equity, then because all of the firm's cash flows must go to either the bondholders or the stockholders, we know that the value of the debt plus the value of the equity must be the value of the firm:

$$V_L = D + E_L \tag{16.2}$$

We also know that the income of the firm must be paid to either the bondholders or the stockholders.[1] Thus, for a firm with income of Y, we have

$$Y = r_A V_L = r_D D + r_E E_L \tag{16.3}$$

Let the fraction of the value of the firm that is financed by debt be D/V_L, and let the fraction of the value of the firm that is financed with equity be E_L/V_L. Then, if we divide Equation (16.3) by the value of the levered firm, V_L, we find that the return on the firm's assets is split proportionately to the bondholders and the stockholders:

$$r_A = \frac{D}{V_L} r_D + \frac{E_L}{V_L} r_E \tag{16.4}$$

Equation (16.4) indicates that the return on the firm's assets is a weighted average of the return on the firm's debt and the return on the firm's equity. The weights reflect the percentages of the valuation of the firm that are financed with debt and equity. Essentially, investors view the firm as a portfolio of assets, with the return on the assets of the firm as the overall portfolio return and the debt and equity as the individual investments. Without taxes, the weighted average cost of capital, r_{WACC}, is the same as the rate of return on the assets of the firm, r_A.

As the firm changes its leverage, the rate of return on its assets remains constant. Because stockholders get paid only after the bondholders are paid, changing the firm's leverage changes the required rate of return on the equity. We can understand this relation by solving Equation (16.4) for r_E:

$$r_E = \frac{V_L}{E_L} r_A - \frac{D}{E_L} r_D = \frac{E_L + D}{E_L} r_A - \frac{D}{E_L} r_D = r_A + \frac{D}{E_L}[r_A - r_D] \tag{16.5}$$

Equation (16.5) indicates that the higher the leverage ratio, D/E_L, the higher the required rate of return on the firm's equity. This makes sense because as the firm issues more debt, less of the firm's cash flow is available to pay the stockholders, which makes their position more risky.

WACC with Taxes

When interest payments can be deducted from a firm's taxes, the firm must only make the after-tax interest payments on its debts. In this situation, as we saw in Chapter 15, issuing debt adds value to the firm. Let the corporate tax rate be τ, and let r_D be the required rate of return on the firm's debt. Then, because interest payments are tax deductible to the corporation, the after-tax required rate of return on the firm's debt is $(1 - \tau)r_D$. We will also let Y represent the after-tax cash flow of the firm, in which case the value of the unlevered firm is unchanged.

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[1]We are discussing payouts of the firm's income as if the firm pays all free cash flow immediately. If a firm retains earnings over and above its investments in capital expenditures and the change in net working capital, the firm must invest those earnings appropriately, or it will destroy value.

Assume that the firm issues an amount of debt to finance the project equal to D and assume that this debt will be perpetually outstanding. Then, from our ANPV analysis in Chapter 15, the present value of the interest tax shield is the discounted sum of the perpetual interest deduction,

$$\frac{\tau r_D D}{(1 + r_D)} + \frac{\tau r_D D}{(1 + r_D)^2} + \frac{\tau r_D D}{(1 + r_D)^3} + \ldots = \frac{\tau r_D D}{r_D} = \tau D \qquad (16.6)$$

The ANPV of the levered firm is the value of the unlevered firm plus the value of the interest tax shield:

$$V_L = V_U + \tau D \qquad (16.7)$$

Now, as before, the cash flows of the firm must be split between the bondholders and the stockholders, but only the after-tax interest is required to be paid:

$$Y = r_D(1 - \tau)D + r_E E_L \qquad (16.8)$$

The weighted average cost of capital, r_{WACC}, is defined as the discount rate that sets the value of the levered firm equal to the discounted present value of the expected, after-tax, all-equity cash flows. For a firm that has a perpetual expected after-tax income of Y, we have

$$V_L = \frac{Y}{r_{\text{WACC}}} \qquad (16.9)$$

If we solve Equation (16.9) for $Y = r_{\text{WACC}} V_L$ and then substitute this result for Y in Equation (16.8), and finally divide by V_L, we find the value of the WACC:

$$r_{\text{WACC}} = \frac{D}{V_L}(1 - \tau)r_D + \frac{E_L}{V_L}r_E \qquad (16.10)$$

Equation (16.10) states that the firm's WACC is the weighted sum of the after-tax required rate of return on the firm's debt and the required rate of return on the firm's equity.

Why r_{WACC} Must Be Less Than r_A

Notice that the weighted average cost of capital, r_{WACC}, is necessarily less than the rate of return on a firm's assets, r_A, because the value of the levered firm, $V_L = Y/r_{\text{WACC}}$, is larger than the value of the unlevered firm, $V_U = Y/r_A$. This insight is important in capital budgeting because in both the ANPV and WACC analyses, the all-equity cash flows are in the numerator. The value of financial side effects is added separately in an ANPV analysis, whereas the WACC analysis includes them in one step.

Why Use WACC?

To understand the intuition for using r_{WACC} as the discount rate for a firm's expected all-equity free cash flows in capital budgeting analyses, consider an example. Suppose a firm has a potential project that provides an expected constant infinite stream of income in each future period. Let the expected value of the annual after-tax cash flow from the project be Y, and let the funds needed to undertake this investment project be I. Now, suppose that the fraction D/V_L of the financing for the project will be done with debt, and the fraction E_L/V_L of the financing for the project will be done with equity.

Some of the income from the project must first be paid to the bondholders to provide the required rate of return on the firm's debt, but the firm only loses the after-tax value of the interest payments because interest is tax deductible:

$$\text{Income paid to bondholders} = r_D(1 - \tau) \times (\text{Value of debt in the project})$$
$$= r_D(1 - \tau) \times (D/V_L)I$$

The rest of the income from the project is paid to the stockholders and provides the return on the firm's equity.[2] If this income is just what the stockholders expected to receive and is equal to their risk-adjusted required rate of return, then

$$\text{Income paid to stockholders} = r_E \times (\text{Value of equity in the project}) = r_E \times (E_L/V_L)I$$

From the perspective of the firm, adding the income paid to the bondholders and the income paid to the stockholders exhausts the income from the project:

$$\text{Income from project} = [r_D(1 - \tau)(D/V_L) + r_E(E_L/V_L)]I = r_{\text{WACC}}I \qquad \text{(16.11)}$$

Now, recognize that a project is a zero net present value investment if the income from the project, Y, just equals the weighted average of the required returns to the firm's bondholders and stockholders, $r_{\text{WACC}} I$. If $Y = r_{\text{WACC}} I$, the net present value (NPV) of the project when discounted at r_{WACC} is 0,

$$\text{NPV} = \frac{Y}{r_{\text{WACC}}} - I = 0$$

If the rate of return on the project provides more expected income than $(r_{\text{WACC}} I)$, the project's rate of return is larger than r_{WACC}, and the project is positive NPV. If the project's rate of return is smaller than r_{WACC}, the project is not a positive NPV project and should not be done.

Example 16.1   WACC Valuation of Teikiko Printing Co.

Suppose that the Teikiko Printing Co. is considering an investment of ¥20 billion in a modernization project. Assume that the company's stockholders require an 8% rate of return, that the company's bondholders require a 4% rate of return, that the Japanese corporate tax rate is 30%, and that 45% of the project will be financed by debt and 55% will be financed with equity.

The previous analysis has equipped us to answer two questions:

- What is Teikiko Printing's WACC?
- What perpetual annual income must the project generate if the project is to be viable, in the sense of being at least a zero net present value investment?

From Equation (16.10), we find that Teikiko Printing's WACC is

$$r_{\text{WACC}} = [0.45 \times (1 - 0.30) \times 0.04] + [0.55 \times 0.08] = 0.0566$$

or 5.66%.

From Equation (16.11), Teikiko Printing will be able to provide the required compensation to its bondholders and its stockholders if the annual income from the project is

$$0.0566 \times \text{¥20 billion} = \text{¥1.132 billion}$$

In this case, the project has a zero net present value because the value of the project, which is the perpetual income divided by the WACC, equals to the cost of the project:

$$\frac{\text{¥1.132 billion}}{0.0566} = \text{¥20 billion}$$

Teikiko should invest in the project only if it is expected to generate at least ¥1.132 billion per year.

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[2]We are intentionally ignoring the possibility of reinvestment of earnings in the firm. This makes no difference as long as the reinvested earnings are invested in zero NPV projects.

Deriving r_A from r_D and r_E

One reason people like the WACC approach to capital budgeting is that it uses the rates of return on traded securities, and the debt and equity shares of the firm. In contrast, the ANPV analysis requires the rate of return on the firm's underlying assets. To derive the required rate of return on the firm's assets, we first equate the two values of the levered firm in Equations (16.2) and (16.7):

$$E_L + D = V_L = V_U + \tau D \tag{16.12}$$

The value of the equity plus the value of the debt must equal the value of the levered firm, which is the value of the unlevered firm plus the interest tax shield. Rearranging Equation (16.12) gives

$$V_U = E_L + (1 - \tau)D \tag{16.13}$$

Because $Y = r_A V_U$ and because the income must be distributed to the bondholders and the stockholders as in Equation (16.8), we can use Equation (16.13) to derive

$$r_A[E_L + (1 - \tau)D] = r_D(1 - \tau)D + r_E E_L \tag{16.14}$$

By solving Equation (16.14) for r_A, we find

$$r_A = \frac{D}{[E_L + (1 - \tau)D]}(1 - \tau)r_D + \frac{E_L}{[E_L + (1 - \tau)D]}r_E \tag{16.15}$$

Once again, the return on the firm's assets is a weighted average of the returns on the firm's debt and equity. The denominator of the weights is the value of the unlevered firm. The weight on the after-tax cost of debt is the ratio of debt to the unlevered firm value, and the weight on the required rate of return on equity is the ratio of the market value of equity to the unlevered firm value. If the firm has accurate estimates of the required rate of return on its levered equity, r_E, and the required rate of return on its debt, r_D, then Equation (16.15) provides the required rate of return on the assets in the ANPV analysis.

Equation (16.15) can also be solved for r_E to get

$$r_E = r_A + \frac{(1 - \tau)D}{E_L}(r_A - r_D) \tag{16.16}$$

Because $r_A > r_D$, Equation (16.16) indicates how leverage increases the required rate of return on the equity of the firm above the required rate of return on the assets of the firm in the presence of an interest deduction for corporate income tax.

Example 16.2   ANPV Valuation of Teikiko Printing

In Example 16.1, Teikiko's WACC was 5.66% when the required rate of return on its debt was 4% and the required rate of return on its equity was 8%. The project was zero NPV because the value of the project just equaled its cost, or ¥20 billion. Now, let's use an ANPV analysis to check our logic.

The value of the debt is 45% of the value of the project or

$$0.45 \times \text{¥20 billion} = \text{¥9 billion}$$

and the value of the equity is

$$\text{¥20 billion} - \text{¥9 billion} = \text{¥11 billion}$$

From Equation (16.16), the required rate of return on the project's unlevered assets is

$$r_A = \frac{¥9}{¥11 + [(1 - 0.30)¥9]}(1 - 0.30)0.04 + \frac{¥11}{¥11 + [(1 - 0.30)¥9]}0.08$$
$$= 0.0654$$

or 6.54%. An ANPV analysis of the project discounts the project's annual after-tax income of ¥1.132 billion at 6.54%, adds the value of the interest tax shield to get the value of the levered project, and subtracts the cost of the project. From Equation (16.7), the ANPV of the project is

$$\frac{¥1.132 \text{ billion}}{0.0654} + (0.30 \times ¥9 \text{ billion}) - ¥20 \text{ billion} = 0$$

The project has a zero ANPV, which was the conclusion of the WACC analysis.

Pros and Cons of Using WACC

The derivation of r_{WACC} presupposes that the project will perpetually provide the expected level of cash flows. It also assumes that the firm continuously monitors the value of its debt and adjusts the debt to keep the ratio of debt to total firm value, D/V_L, constant (see Miles and Ezzell, 1980). Hence, using a constant r_{WACC} in some situations is incorrect and leads to valuation mistakes. For example, you should not use a constant r_{WACC} if the project's leverage is changing, which is often the case in leveraged buyouts, for example.[3] Equation (16.16) indicates that changing leverage changes the required return on the firm's equity, which in turn changes the WACC. In situations of changing leverage, it is better to assume that the rate of return on the firm's assets is constant rather than the WACC.

In the ANPV analysis in Chapter 15, we clearly stated that the discount rate is a project-specific concept. Similarly, in international capital budgeting using a WACC analysis, the cost of capital should be specific to the international project. Using the same WACC for all projects is particularly troublesome for international capital budgeting applications in which foreign currency cash flows are converted into domestic currency and then discounted with a domestic currency discount rate. The nature of cash flow uncertainty when operating in a foreign country, along with the uncertainty of foreign exchange rate changes, can alter the riskiness of the cash flows. As a result, the riskiness of foreign cash flows can be different from the riskiness of domestic cash flows, even if the two projects are similar.

The Flow-to-Equity Method of Capital Budgeting

The third approach to capital budgeting is the flow-to-equity (FTE) method, which is based on the fact that the equity value of a firm is the present discounted value of the expected cash flows to stockholders, discounted at the required rate of return on the equity, r_E. In our analysis, we treated Y as the value of the perpetual after-tax cash flow to the all-equity firm. If the firm has perpetual debt of D, the stockholders do not receive Y each period. The stockholders must first pay the interest on the debt, but they can deduct the interest payments and pay less in taxes. Thus, the stockholders can expect to receive $Y - (1 - \tau)r_D D$ each period.

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[3]In a leveraged buyout (LBO), a firm is converted from a publicly traded corporation into a private corporation. The purchasers of the outstanding equity often use large amounts of debt, which they plan on paying down over time.

By discounting the value of what stockholders expect to receive at the required rate of return on the equity, we find the value of the levered equity:

$$E_L = \frac{Y - (1 - \tau)r_D D}{(1 + r_E)^1} + \frac{Y - (1 - \tau)r_D D}{(1 + r_E)^2} + \frac{Y - (1 - \tau)r_D D}{(1 + r_E)^3} + \cdots$$

$$= \frac{Y - (1 - \tau)r_D D}{r_E} \tag{16.17}$$

The Equivalence of FTE to Other Approaches

For the firm with perpetual cash flows that we've been discussing in this chapter, it is straightforward to demonstrate that the FTE approach is equivalent to the WACC approach. If it is, then $E_L + D = V_L = Y/r_{\text{WACC}}$. Let's assume that this is true and confirm that we can produce the same WACC. We begin by rearranging Equation (16.17) by multiplying both sides by r_E and moving the debt terms to the other side:

$$Y = r_E E_L + (1 - \tau) r_D D \tag{16.18}$$

Dividing on both sides of Equation (16.18) by the value of the levered firm, V_L, we find

$$\frac{Y}{V_L} = \frac{r_E E_L + (1 - \tau)r_D D}{V_L} = r_{\text{WACC}} \tag{16.19}$$

Thus, by assuming that the levered firm value is the same in the two cases, we have demonstrated that we produce the same value of r_{WACC}. Thus, the equity value derived from the FTE method is consistent with the equity value found in the WACC analysis.

Example 16.3 FTE Valuation of Teikiko Printing Co.

Let's find the equity value of the Teikiko Printing Co. from the previous examples, using the flow-to-equity method of valuation. Remember that the project's expected annual after-tax income to the all-equity firm was ¥1.132 billion and that it was zero NPV and cost ¥20 billion. The required rates of return are 4% on the debt and 8% on the equity. The firm will issue ¥9 billion of debt. With this information, what is the value of the levered equity from the FTE approach?

Because the corporate tax rate is 30%, the expected annual after-tax income to the stockholders of the firm is

¥1.132 billion $-$ $(1 - 0.30) \times 0.04 \times$ ¥9 billion $=$ ¥0.880 billion

This income is expected to be paid perpetually. We find the discounted present value of the cash flows to stockholders by dividing by the required rate of return on the equity:

$$\frac{\text{¥0.880 billion}}{0.08} = \text{¥11 billion}$$

Thus, the FTE approach to capital budgeting tells us that the Teikiko's equity is worth ¥11 billion. This is the amount of money that the stockholders would have to contribute to the project because they can borrow ¥9 billion. Because the cost of the project to the stockholders is equal to the value of the project to the stockholders, the project has a zero net present value.

The Pros and Cons of Alternative Capital Budgeting Methods

In Chapter 15 and the first part of this chapter, we presented three capital budgeting methods: the adjusted net present value (ANPV), the weighted average cost of capital (WACC), and the flow-to-equity (FTE) methods. If used appropriately, the three methods give the same present value of a project.

We stressed the ANPV approach because it categorizes the sources of value and thus lets a manager make an informed decision about the economic profitability of a project versus other sources of value coming from financing and growth. The ANPV approach also provides a great way to discuss risk management and the desirability of hedging foreign exchange risk, which we do in Chapter 17. In addition, the ANPV approach works well for international projects, such as the project being considered by International Wood Products, Inc. (discussed in Chapter 15), in which the firm knows the level of debt. It is also straightforward to value subsidized financing, which is often missed in a WACC analysis. Sometimes, though, the other approaches are easier to use.

The ANPV approach assumes that the manager knows the level of debt in future periods. If, instead, managers are planning to keep the debt–equity ratio constant, as is assumed in the WACC approach, then calculating an ANPV is problematic because the amount of debt depends on the amount of equity and vice versa. Conversely, if the level of debt is going to be changing over time because the firm has subsidized debt that will not be replaced, for example, then the leveraged equity required rate of return, r_E, will be changing, even if the risk-adjusted rate of return on the assets of the firm, r_A, is constant. With changing future values of r_E, both WACC and FTE are difficult to apply. ANPV works best in such situations. Because each of the three methods works well in different situations, it is important to have them all in your tool kit.

16.2 FORECASTING CASH FLOWS OF FOREIGN PROJECTS

The Choice of Currency

Generally, a significant part of the revenue earned by international projects is denominated in foreign currencies because the project's products are sold throughout the world. Multinational corporations also typically have costs that are denominated in foreign currencies because they source raw materials and intermediate goods in a global market.

Because an international project's cash flows are denominated in different currencies, the first decision in an international valuation is whether to do the valuation using forecasts denominated in a foreign currency or in the domestic currency. Later in the chapter, an extended case demonstrates how international capital budgeting can be done in either currency. We also examine what it takes for the two approaches to result in the same domestic currency value.

As discussed in Chapter 15, we can use a straightforward approach to find the value of a foreign project by forecasting the future foreign currency cash flows and discounting them to the present, using an appropriate foreign currency discount rate. The current value of the foreign project in domestic currency is then determined by multiplying the present value denominated in the foreign currency by the current spot exchange rate between the two currencies. One problem with this approach is that it is sometimes difficult to determine the appropriate foreign currency discount rate.

The second way to determine the value of a foreign project is to forecast the foreign currency value of the cash flows and then multiply them by the corresponding forecasts of future exchange rates. The result is a measure of the expected future domestic currency value of the

foreign cash flows. Then, using an appropriate domestic currency discount rate to take the present values gives the current value of the foreign project in domestic currency.

Reconciling the Two Methods for Discounting Foreign Cash Flows

To see the equivalence of the two methods for discounting foreign cash flows, let $X(t+k)$ be the foreign currency cash flow at time $t+k$, which is k years in the future, and let $S(t+k)$ be the exchange rate of domestic currency per unit of foreign currency at time $t+k$. Then, $E_t[X(t+k)]$ is the forecast, or expected value of the future foreign currency cash flow, and $E_t[S(t+k)]$ is the forecast, or expected value, of the future exchange rate. Let $r(FC, k)$ and $r(DC, k)$ be the appropriate risk-adjusted discount rates in the foreign currency and domestic currency, respectively, that are used to discount the expected cash flows generated in year $t+k$ back to year t.

Using the first method for discounting foreign cash flows takes the foreign currency denominated present value of the future cash flow, which is $\dfrac{E_t[X(t+k)]}{[1 + r(FC, k)]^k}$, and converts this into domestic currency by multiplying by $S(t)$. Hence, the domestic currency denominated present value of the future foreign currency cash flow is $\dfrac{S(t)E_t[X(t+k)]}{[1 + r(FC, k)]^k}$.

The second method for discounting foreign cash flows is based on using a domestic currency forecast of the future foreign currency cash flows and then applying a domestic currency discount rate. You can think of this as directly forecasting the product of the exchange rate and the foreign currency cash flow, $E_t[S(t+k)X(t+k)]$, and then using a home currency discount rate. As a practical matter, no one does this. Instead, we first calculate the foreign currency forecasts and then multiply by the forecasts of the exchange rate, $E_t[S(t+k)]E_t[X(t+k)]$, to get the domestic currency value of the future cash flows. We then take the present value using the domestic currency discount rate, $r(DC, k)$. Thus, the domestic currency denominated present value of the future foreign currency cash flow using the second method is $\dfrac{E_t[S(t+k)]E_t[X(t+k)]}{[1 + r(DC, k)]^k}$.[4]

Equating the two methods of discounting the value of future foreign currency cash flows gives

$$\frac{S(t)E_t[X(t+k)]}{[1 + r(FC, k)]^k} = \frac{E_t[S(t+k)]E_t[X(t+k)]}{[1 + r(DC, k)]^k} \tag{16.20}$$

Simplifying Equation (16.20) by dividing both sides by the expected foreign currency cash flow and the current exchange rate and multiplying both sides by 1 plus the discount factors raised to the k power gives

$$[1 + r(DC, k)]^k = [1 + r(FC, k)]^k \frac{E_t[S(t+k)]}{S(t)} \tag{16.21}$$

Equation (16.21) indicates that the two approaches are the same when the discount rates satisfy a parity condition exactly like uncovered interest rate parity, which is discussed in Chapter 7. The foreign currency discount rate will be higher than the domestic currency discount rate if the foreign currency is expected to depreciate relative to the domestic currency, in which case $E_t[S(t+k)] < S(t)$.

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[4]If you are forecasting the product of the exchange rate and the foreign currency cash flow, the domestic currency discount rate is slightly different unless the exchange rate and the foreign currency cash flow are uncorrelated.

It is important to notice that the discount rates will usually be different for different time periods. We know that unless the term structures of interest rates in the two currencies are flat, the expected rate of appreciation will be different for different periods. Therefore, if the discount rate is the same across maturities in one currency, it cannot be the same across maturities in the other.

The next section examines the valuation of a foreign project using the two methods. We consider an international capital budgeting case in which expected changes in real exchange rates play a role in the valuation of a foreign project.

16.3 CASE STUDY: CMTC'S AUSTRALIAN PROJECT

It was early Friday evening in St. Louis, Missouri, and Donna Elichalt was still staring at her computer screen. Donna had recently been promoted from financial analyst to assistant treasurer for international operations of the Consolidated Machine Tool Company (CMTC) with sales in 39 countries and manufacturing operations in seven countries.

Elichalt had been asked by CMTC's chief financial officer (CFO) to evaluate a capital budgeting request from CMTC's Australian subsidiary. The project was the largest request that she had ever analyzed. Rather than a weekend away from the office, it now was beginning to look as though she would be at the office all night.

The Australian Investment Proposal

CMTC's Australian plant manager, Rod Wickens, had submitted a proposal to spend 47 million Australian dollars to reengineer his plant with new robotics and other computerized machinery. At the current exchange rate of USD1.35/AUD, the request was for USD63.45 million. Such an expenditure would severely cut into the free cash flow of the Australian subsidiary and would eliminate any possibility of a dividend from Australia this year. In his proposal, Wickens indicated that the investment in new equipment promised significant cost savings in the future. He also argued that the project's cost would be partially offset by the sale of old equipment for AUD11.83 million.

Elichalt had met Wickens on several occasions, and while she thought he probably did production well, she wasn't sure that he really understood the importance of a proper discounted cash flow analysis of investment projects. Wickens usually wanted to do any project that lowered his future costs, especially if the payback on the project was within 5 years. He often justified this attitude with statements such as "CMTC can't be profitable if our costs are higher than our competitors' costs."

The Australian plant was not CMTC's oldest, but Elichalt knew that CMTC planned to close the Australian plant in 10 years, when it would expand CMTC's operations in China. With low Chinese labor costs and growing demand for machine tools, operating from China made sense. Elichalt consequently knew that only 10 years of expected cash flows from the Australian plant would need to be considered.

In his proposal to reengineer the plant, Wickens indicated that the current AUD costs of production were AUD45.375 million per year. He argued that AUD costs of production would probably increase at the Australian rate of inflation for the remaining life of the plant. On the other hand, Wickens argued that after the reengineering of the plant, manufacturing costs could be expected to be 90% of the old costs in the first year, 85% in the second year, and 80% in the remaining years of the plant's existence. Elichalt wondered if such expected cost savings justified the project's large initial expenditure.

Because Wickens had not provided any explicit future cash flow projections, Elichalt's first job was to forecast the after-tax AUD cash flows of the project. She then needed to

discount these expected cash flows to the present, using appropriate discount factors. She wasn't sure whether to discount the expected cash flows in Australian dollars or to first convert the expected cash flows into U.S. dollars. If she wanted to discount the cash flows in U.S. dollars, she would need forecasts of future exchange rates, whereas if she discounted them in Australian dollars, she would just have to get the AUD discount rate right.

Gathering the Economic Data

To begin her analysis, Elichalt had placed a call to the economic analysis group at Golder Sax, an investment bank, to get interest rate data and forecasts of inflation rates for Australia and the United States. Elichalt's contact at Golder Sax easily provided both USD and AUD interest rates, which are in Exhibit 16.1. The analyst indicated that these term structures of interest rates referred to the spot interest rates in each currency that are the pure discount bond yields in the respective currencies.[5] The analyst indicated that the annual forecasts of AUD and USD inflation rates included in Exhibit 16.1 were the consensus forecasts of business economists.

Expected 1-Year Real Interest Rates

The Golder Sax analyst also included annual expected real interest rates for each currency. He showed how they were derived from the market-determined nominal interest rates for different maturities and the forecasts of future inflation rates to reflect the expected real return on a one-period investment that begins a number of years in the future. That is, $r^e(t, k)$ is the 1-year real rate of return that is expected to prevail k years in the future. Let $i(t,k)$ be the k-year spot nominal interest rate at time t for payoffs k years in the future, and let $\pi^e(t, k)$ be the expected annual rate of inflation at time t for year $t+k$. One unit of currency borrowed for k years generates a liability of $[1 + i(t, k)]^k$ that must be paid in the future at time $t+k$. The one unit of borrowed currency can be invested in the $(k-1)$-year bond to get a payoff of $[1 + i(t, k-1)]^{k-1}$ at time $t+k-1$. When that payoff is received, the proceeds from investing in the $(k-1)$-year bond can be invested at the 1-year interest rate, $i(t+k-1, 1)$, that will be known at the end of year $t+k-1$ and will pay off at the end of year $t+k$. Because the strategy requires no investment today, the expected return must equal the expected cost, ignoring risk premiums. Thus,

$$\{1 + E_t[i(t+k-1, 1)]\} [1 + i(t, k-1)]^{k-1} = [1 + i(t, k)]^k \qquad \textbf{(16.22)}$$

Exhibit 16.1 Information on Australian and U.S. Interest Rates and Inflation Rates

	Year in the Future									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1. USD Spot Rates	1.50	2.19	2.70	3.07	3.36	3.61	3.83	4.02	4.19	4.34
2. AUD Spot Rates	12.78	11.77	11.14	10.66	10.29	9.97	9.70	9.46	9.25	9.07
3. USD Expected Inflation	1.25	2.13	2.33	2.44	2.50	2.54	2.57	2.59	2.61	2.63
4. AUD Expected Inflation	7.00	5.50	5.00	4.75	4.60	4.50	4.43	4.38	4.33	4.30
5. USD Expected Real Rates	0.25	0.75	1.35	1.70	2.00	2.75	2.50	2.70	2.90	3.00
6. AUD Expected Real Rates	5.40	5.00	4.65	4.30	4.00	3.75	3.50	3.30	3.10	3.00

Notes: The term structures of interest rates are the spot rates appropriate for discounting a known future cash flow k years in the future. The expected inflation rates represent analysts' forecasts. The expected real interest rates are derived in Equation (16.24).

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[5]Chapter 6 explains the term structure of spot interest rates and the relationship between bond prices and pure discount bond yields.

The Fisher equation implies that 1 plus the expected nominal interest rate can be broken into 1 plus the expected real interest rate multiplied by 1 plus the expected rate of inflation, or

$$\{1 + E_t[i(t{+}k{-}1, 1)]\} = [1 + r^e(t, k)][1 + \pi^e(t, k)] \tag{16.23}$$

Substituting from Equation (16.23) into Equation (16.22) and solving for $[1 + r^e(t, k)]$ gives

$$[1 + r^e(t, k)] = \frac{[1 + i(t, k)]^k}{[1 + i(t, k{-}1)]^{k-1}[1 + \pi^e(t, k)]} \tag{16.24}$$

These real interest rates will later be linked to the expected real depreciation of the Australian dollar.

Book Value and Depreciation

To begin the task of constructing expected cash flows, Elichalt checked with CMTC's accounting department and determined that the book value of the Australian plant's existing equipment was AUD10.5 million. Hence, the sale of the old equipment would generate some taxable income. Accounting had also informed Elichalt the old equipment had 5 years of remaining accounting depreciation and that straight-line depreciation was being used. The new equipment would be depreciated on a straight-line basis over the course of 10 years. Finally, the accounting group noted that a 40% tax rate was the appropriate rate to apply to the AUD cash flows. Armed with this information, Elichalt knew that she could generate appropriate forecasts of AUD cash flows. Only the discount rate remained to be settled.

Discounted Cash Flows

As she reached for her well-thumbed copy of Bekaert and Hodrick's *International Financial Management*, Elichalt remembered that they advocated using equity discount rates that reflect both the spot nominal interest rates for each period and the riskiness of the individual project's equity cash flows. Elichalt knew that historically the AUD profits of the Australian subsidiary, when converted into USD, were quite similar to the USD equity returns of other CMTC plants. Hence, she knew that a USD equity risk premium of 5.5% seemed appropriate when discounting expected USD cash flows from the Australian subsidiary.

But Elichalt also knew that Wickens would want to see an analysis done in Australian dollars. This raised the question of whether it mattered if the analysis were done in U.S. dollars or in Australian dollars. Elichalt didn't relish a clash with Wickens or the CFO on Monday.

Case Solution

Elichalt's solution proceeds in several logical steps. First, Exhibit 16.2 presents the AUD after-tax cash flows in millions of AUD forecast for the current year and the next 10 years. Each of the lines is explained below. Then, Exhibit 16.3 presents forecasts of expected USD per AUD exchange rates that are used in Exhibit 16.4 to derive the expected dollar cash flows from the project. These are discounted using USD equity discount rates. Exhibit 16.5 then demonstrates how the analysis can be done directly in Australian dollars.

Initial Cash Flows

Line 1 of Exhibit 16.2 gives the net investment, which is the initial outlay of AUD47 million minus the after-tax value from selling the old equipment. Selling the old equipment for AUD11.83 million partially offsets the project's initial cost, but because the market price of

Exhibit 16.2 Projected Project Cash Flows in Millions of Expected Australian Dollars

	0	1	2	3	4	5	6	7	8	9	10
					Year in the Future						
1. Net Investment	−35.70										
2. Old Cost		48.55	51.22	53.78	56.34	58.93	61.58	64.31	67.12	70.03	73.04
3. New Cost		43.70	43.54	43.03	45.07	47.14	49.26	51.45	53.70	56.02	58.43
4. After-Tax Cost Saving		2.91	4.61	6.45	6.76	7.07	7.39	7.72	8.05	8.40	8.76
5. Old Dep. Tax Shield		−0.84	−0.84	−0.84	−0.84	−0.84					
6. New Dep. Tax Shield		1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.88
7. AUD Cash Flow	−35.70	3.95	5.65	7.49	7.80	8.11	9.27	9.60	9.93	10.28	10.64

the old equipment is greater than its AUD10.5 million book value, CMTC generates taxable income. The after-tax benefit is the price of the old equipment minus the income tax rate multiplied by the difference between the sale price and the book value of the old equipment:

$$\text{AUD11.83 million} - 0.40 \times (\text{AUD11.83 million} - \text{AUD10.5 million})$$
$$= \text{AUD 11.30 million}$$

Thus, CMTC's net investment is

$$\text{AUD35.70 million} = \text{AUD47 million} - \text{AUD11.30 million}$$

The After-Tax Cost Savings of the Project

Line 2 of Exhibit 16.2 shows forecasts of the plant's old costs. As Wickens indicated, old costs are expected to increase at the AUD rate of inflation for years 1 through 5. Thus, if $\pi^e(t, k, \text{AUD})$ is the forecast at time t of the annual AUD rate of inflation k years in the future, old costs in year $t+k$ are expected to be

Old costs in k years $= [1 + \pi^e(t, k, \text{AUD})] \times [\text{Old costs in } (k–1) \text{ years}], k = 1, \ldots ,10$

For example, costs in year 0 are AUD45.375 million and the expected AUD rate of inflation in year 1 is 7%. Thus, first-year costs are expected to be

$$\text{AUD45.375 million} \times 1.07 = \text{AUD48.55 million}$$

Line 3 of Exhibit 16.2 shows forecasts of new costs. These were generated according to the percentage savings that Wickens predicted over the next 10 years:

New costs in year 1 $= 0.90 \times (\text{Old costs in year 1})$
New costs in year 2 $= 0.85 \times (\text{Old costs in year 2})$
New costs in year $k = 0.80 \times (\text{Old costs in year } k), k = 3, \ldots ,10$

Line 4 of Exhibit 16.2 shows the expected after-tax cost savings, which are the differences between the forecasts of old costs and new costs for year k multiplied by one minus the tax rate of 40%. It is assumed that the new equipment will produce machine tools that are identical to the ones that CMTC would have sold but that the new equipment will do so more cheaply. CMTC consequently forecasts that it will sell exactly as many machine tools in the future if the investment is made, but each machine tool it sells will generate more profit because it will be produced at lower cost. Of course, because CMTC will be more profitable, it will have to pay income tax on the additional profit. Hence, the after-tax value of the cost savings, listed in Line 5 of Exhibit 16.2, provides the primary benefit of the project.

Depreciation Tax Shields

Depreciation of equipment is an accounting cost that reduces the before-tax income of the firm. If the firm generates a before-tax cash flow of Y and takes depreciation of Dep, the before-tax income of the firm is $(Y - Dep)$. If the corporate tax rate is τ, the firm's after-tax income is $(1 - \tau)(Y - Dep)$. Because depreciation is not a cash flow, we must add Dep to after-tax income to get the firm's after-tax cash flow:

$$(1 - \tau)(Y - Dep) + Dep = (1 - \tau)Y + \tau Dep$$

Depreciation provides a tax benefit to the project, which is often called the depreciation tax shield, equal to the tax rate multiplied by depreciation. Line 5 of Exhibit 16.2 recognizes that when the old equipment is sold, CMTC will lose the remaining 5 years of depreciation tax shields associated with the old equipment. With the straight-line method of depreciation, the lost depreciation expense in years 1 through 5 would be one-fifth (20%) of the book value of the equipment, which is AUD10.5 million. Hence, the firm will lose a depreciation tax shield of

$$(0.40) \times (0.20) \times (\text{AUD10.5 million}) = \text{AUD0.84 million}$$

in each year of the first 5 years of the project.

Because the firm is purchasing new equipment, it will generate new depreciation tax shields, which are given in Line 6 of Exhibit 16.2. The new depreciation tax shield recognizes that the life of the equipment is 10 years. Hence, 10% of the value of the purchase will be deducted in each of the next 10 years, and the tax rate multiplied by this value provides the new depreciation tax shield:

$$(0.40) \times (0.10) \times (\text{AUD47 million}) = \text{AUD1.88 million}$$

The Total Expected After-Tax Cash Flows in Australian Dollars

The expected total after-tax AUD cash flows of the project are given in Line 7 of Exhibit 16.2. The year 0 value is net investment in Line 1. The cash flows in years 1 through 10 are the sums of the after-tax cost savings in Line 4 and the depreciation tax shields in Lines 5 and 6. To determine whether or not the project is acceptable, we must take the present value of these cash flows, either in Australian dollars or in U.S. dollars, after converting them to expected U.S. dollars.

The equipment is assumed to be fully depreciated and of zero economic value after the end of the 10-year forecast period. If this were not the case, some terminal value or residual salvage value of the equipment would be available as an additional benefit of the project.

Forecast Future Spot Rates

Expected future spot exchange rates are easily constructed from the current spot rate and the term structures of spot interest rates in each currency that are supplied in Exhibit 16.1. Let $S(t)$ denote the current spot rate of USD per AUD, which is USD1.35/AUD. Let $i(t, k, \text{AUD})$ denote the nominal AUD k-year spot interest rate at time t. For example, the 5-year AUD interest rate is 10.29% in Exhibit 16.1. Let $i(t, k, \text{USD})$ denote the nominal USD k-year spot interest rate at time t and notice that the 5-year USD interest rate is 3.36% in Exhibit 16.1. Then, from interest rate parity, a k-year forward rate of USD per AUD that was quoted at time t for delivery in year $t+k$ would satisfy

$$F(t, k) = S(t) \times \frac{[1 + i(t, k, \text{USD})]^k}{[1 + i(t, k, \text{AUD})]^k} \tag{16.25}$$

Substituting the current spot rate and the 5-year interest rates into Equation (16.25), we find an implicit forward rate at time t for year $t+5$ of

$$\frac{\text{USD1.35}}{\text{AUD}} \times \frac{(1.0336)^5}{(1.1029)^5} = \frac{\text{USD0.98}}{\text{AUD}}$$

Exhibit 16.3 Forecasts of U.S. Dollar–Australian Dollar Exchange Rates from Interest Rate Parity

	Year in the Future										
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1. USD/AUD	1.35	1.22	1.13	1.07	1.02	0.98	0.94	0.92	0.90	0.88	0.87
2. Rate of AUD Depreciation		10.00	7.12	5.61	4.65	3.89	3.29	2.73	2.28	1.84	1.61

Because AUD nominal interest rates are substantially higher than USD nominal interest rates, the Australian dollar is at a large discount in the forward market.

In the absence of information about a risk premium in the forward foreign exchange market, Equation (16.25) can be used to generate expected future spot exchange rates. That is, we can assume that the implicit forward rates are unbiased predictors of future spot rates:

$$F(t, k) = E_t[S(t+k)] \tag{16.26}$$

Line 1 of Exhibit 16.3 presents expected future spot exchange rates constructed in this way from Equations (16.25) and (16.26) using the data of Exhibit 16.1. Line 2 expresses the annual expected rates of depreciation of the Australian dollar relative to the U.S. dollar implicit in these forecasts. These will be used in a later analysis.

Assuming that the future spot exchange rates and the AUD cash flows from the project are independent, the expected after-tax AUD cash flows of the project, $E_t[X(t+k, \text{AUD})]$, can be converted into expected USD cash flows by multiplying by the forecast of the exchange rate in year $t+k$ from Exhibit 16.3:

$$\text{Expected value at time } t \text{ of U.S. dollars in year } t+k = E_t[X(t+k, \text{AUD})] \\ \times E_t[S(t+k)] \tag{16.27}$$

For example, the forecast for year 1 of the AUD after-tax cash flow from Exhibit 16.2 is AUD3.95 million, and the forecast of the exchange rate for year 1 from Exhibit 16.3 is USD1.2150/AUD. Hence, the forecast of USD value of the AUD cash flows in year 1 is

$$\text{AUD3.95 million} \times \frac{\text{USD1.2150}}{\text{AUD}} = \text{USD4.80 million}$$

The present value of the expected USD cash flows calculated in Equation (16.27) is found by discounting them at USD equity discount rates, $r_E(t, k, \text{USD})$:

$$\text{Present value at time } t \text{ of expected USD in year } t+k \\ = \frac{E_t[X(t+k, \text{AUD})] \times E_t[S(t+k)]}{[1 + r_E(t, k, \text{USD})]^k} \tag{16.28}$$

The U.S. Dollar Discount Rates

The choice of appropriate USD discount rates for the expected USD cash flows involves two considerations. First, from the spot interest rates, we know that the time value of money is not the same across maturities. Thus, the USD equity discount rates should also reflect this fact. The second consideration is that the projected USD cash flows are not risk free. Because the realized profits from the Australian subsidiary are equity cash flows, it is appropriate to discount the expected cash flows with discount rates that reflect the riskiness of the equity. We are told that Elichalt thinks that a 5.5% USD equity risk premium is appropriate.

Exhibit 16.4   Net Present Value of the Project in Millions of U.S. Dollars

	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
						Year in the Future					
1. AUD Cash Flows	−35.70	3.95	5.65	7.49	7.80	8.11	9.27	9.60	9.93	10.28	10.64
2. USD/AUD	1.35	1.22	1.13	1.07	1.02	0.98	0.94	0.92	0.90	0.88	0.87
3. USD Cash Flows	−48.20	4.80	6.38	7.98	7.92	7.92	8.75	8.81	8.92	9.06	9.23
4. USD Discount Rates		7.00	7.69	8.20	8.57	8.86	9.11	9.33	9.52	9.69	9.84
5. USD Present Values	−48.20	4.49	5.50	6.30	5.70	5.18	5.19	4.72	4.31	3.94	3.61

USD NPV @ Variable Rates = 0.74   USD NPV @ 9.84% = −0.86

Consequently, the appropriate USD equity discount rates are the USD nominal risk-free interest rates plus 5.5%:

$$r_E(t, k, \text{USD}) = i(t, k, \text{USD}) + 5.5$$

These USD equity discount rates are presented in Line 4 of Exhibit 16.4.

The Net Present Value of the Project in U.S. Dollars

The present values corresponding to Equation (16.28) are presented in Line 5 of Exhibit 16.4. The sum of these present values is USD0.74 million. Because the project is positive NPV, it should be accepted.

How Incorrect Discounting Leads to Problems

Often in actual capital budgeting analyses, a single discount rate is used for all the future cash flows. If a 10-year project is being analyzed, the 10-year discount rate is used for all years. Sometimes this is an innocuous assumption, if the term structure of interest rates is reasonably flat, but it is not innocuous in this case. Exhibit 16.4 indicates that if each of the 10 years of expected USD cash flows is discounted by the 10-year USD equity discount factor, which is 9.84%, the project has a negative NPV of –$0.86 million.

The project is negative NPV when this incorrect method is used because the term structure of USD interest rates is upward sloping. An upward-sloping term structure of spot interest rates indicates that expected future USD short-term nominal interest rates are higher than current short-term interest rates. Hence, longer-term expected USD cash flows require higher discount rates than nearer-term cash flows. If the expected USD profits from the early years of the project are discounted by the high USD rate of return that is appropriate only for discounting cash flows in year 10, the present value of the project is penalized needlessly.

The Net Present Value of the Project in Australian Dollars

The previous analysis derives the net present value of the project in U.S. dollars by discounting the expected USD cash flows with USD equity discount rates. It is also possible to derive a USD NPV for the project by first discounting the expected AUD cash flows with appropriate AUD equity discount rates, $r_E(t, k, \text{AUD})$:

Present value at time t of expected AUD in year $t+k$

$$= \frac{E_t[X(t+k, \text{AUD})]}{[1 + r_E(t, k, \text{AUD})]^k} \qquad \text{(16.29)}$$

The USD NPV of the project can subsequently be found by multiplying the AUD NPV by the current spot rate of USD per AUD:

USD present value at time t of expected AUD in year $t+k$

$$= \frac{E_t[X(t+k, \text{AUD})]}{[1 + r_E(t, k, \text{AUD})]^k} \times S(t) \qquad (16.30)$$

If the two methods of deriving a USD NPV are to provide the same value, the expression in Equation (16.28) must equal the expression in Equation (16.30) from which we find the following equality:

$$\frac{E_t[X(t+k, \text{AUD})]}{[1 + r_E(t, k, \text{AUD})]^k} \times S(t) = \frac{E_t[X(t+k, \text{AUD})] \times E_t[S(t+k)]}{[1 + r_E(t, k, \text{USD})]^k} \qquad (16.31)$$

The relation between the AUD discount rate and the USD discount rate in Equation (16.31) can then be written as

$$[1 + r_E(t, k, \text{AUD})]^k = [1 + r_E(t, k, \text{USD})]^k \times \frac{S(t)}{E_t[S(t+k)]} \qquad (16.32)$$

By solving Equation (16.31) for the AUD discount rate, we find

$$r_E(t, k, \text{AUD}) = [1 + r_E(t, k, \text{USD})] \times \left(\frac{S(t)}{E_t[S(t+k)]} \right)^{1/k} - 1 \qquad (16.33)$$

From the derivation of the expected rates of depreciation of the Australian dollar relative to the U.S. dollar in Exhibit 16.3, we know that we can calculate

$$\frac{S(t)}{E_t[S(t+k)]} = \frac{[1 + i(t, k, \text{AUD})]^k}{[1 + i(t, k, \text{USD})]^k} \qquad (16.34)$$

We can substitute these market-determined forecasts in Equation (16.34) into Equation (16.33). Alternatively, we could use proprietary forecasts of expected rates of appreciation of the U.S. dollar relative to the Australian dollar, but we should have a reason why our proprietary forecasts differ from the market forecasts. In either case, we generate the necessary AUD discount rates.

Notice that the expected rate of depreciation of the Australian dollar relative to the U.S. dollar over the next k years, when expressed at an annual rate as in Equation (16.33) by taking the $(1/k)$-th power of the ratio of the current spot rate to the expected future spot rate, is just the ratio of 1 plus the spot nominal interest rate on the Australian dollar for k years in the future to 1 plus the spot nominal interest rate on the U.S. dollar for k years in the future:

$$\left(\frac{S(t)}{E_t[S(t+k)]} \right)^{1/k} = \frac{[1 + i(t, k, \text{AUD})]}{[1 + i(t, k, \text{USD})]} \qquad (16.35)$$

By substituting from Equation (16.35) into Equation (16.33), we find

$$r_E(t, k, \text{AUD}) = [1 + r_E(t, k, \text{USD})] \times \frac{[1 + i(t, k, \text{AUD})]}{[1 + i(t, k, \text{USD})]} - 1 \qquad (16.36)$$

The values of the AUD equity rates of return that satisfy Equation (16.36) are given in Line 2 of Exhibit 16.5.

When the expected AUD cash flows are discounted at these required equity rates of return, the NPV of the project is AUD0.55 million. Multiplying the AUD NPV by the current exchange rate of USD1.35/AUD gives the USD NPV of $0.74 million. Notice that this is the

Exhibit 16.5 Net Present Value of the Project in Millions of Australian Dollars

	0	1	2	3	4	5	6	7	8	9	10
					Year in the Future						
1. AUD Cash Flow	−35.70	3.95	5.65	7.49	7.80	8.11	9.27	9.60	9.93	10.28	10.64
2. AUD Discount Rates		18.89	17.79	17.09	16.57	16.15	15.81	15.51	15.25	15.02	14.82
3. AUD Present Values	−35.70	3.33	4.07	4.67	4.22	3.84	3.84	3.50	3.19	2.92	2.67

AUD NPV @ Variable Rates = 0.55
Corresponding USD NPV = 0.74

AUD NPV @ 14.82% = 2.15
Corresponding USD NPV = 2.90

same value we found by discounting the expected USD cash flows at the USD required rate of return.

An Incorrect Approach—Again

We demonstrated that if the expected USD cash flows are discounted at the common discount rate associated with the 10-year maturity, the project would have a negative USD NPV. This occurred because using a common discount rate ignores expected changes in USD interest rates, which in this case are expected to increase over time.

Analogously, we get the wrong present value for the project if each of the 10 years of expected AUD cash flows is incorrectly discounted by the common 10-year AUD discount rate, which is 14.82%. If we discount with this common rate, the project has an even larger positive NPV in Australian dollars. Exhibit 16.5 indicates that this value is AUD2.15 million, which is $2.90 million when converted at the current exchange rate.

The reason the value of the project is higher when this incorrect method is used is that the term structure of AUD interest rates is downward sloping. A downward-sloping term structure indicates that future short-term nominal AUD interest rates are expected to be lower than current short-term interest rates. Hence, longer-term AUD cash flows should be discounted at lower discount rates, and nearer-term AUD cash flows should be discounted at higher rates. If the expected AUD profits from the early years of the project are discounted by the low AUD rate of return that is appropriate only for year 10 cash flows, the value of the project appears to be more favorable than it actually is.

The Expected Real Depreciation of the Australian Dollar

The nominal interest rates for the two currencies imply that the Australian dollar is expected to depreciate relative to the U.S. dollar in nominal terms, as demonstrated in Exhibit 16.3. Given the expected rates of inflation from Exhibit 16.1, we can also determine that the Australian dollar is expected to depreciate relative to the U.S. dollar in real terms. This is demonstrated in Exhibit 16.6. Knowing that the Australian dollar is expected to weaken in real terms is important because it implies that the forecast USD cash flows from the project that might be generated from an assumption of relative purchasing power parity would seriously overvalue the project.

Exhibit 16.6 Forecasts of Real Depreciation of the AUD

	1	2	3	4	5	6	7	8	9	10
					Year in the Future					
1. Depreciation per Year	4.89	4.05	3.15	2.49	1.92	1.45	0.97	0.58	0.19	0.00
2. Compounded	4.89	8.74	11.61	13.82	15.47	16.70	17.50	17.98	18.14	18.14

Using purchasing power parity (PPP) to forecast foreign currency cash flows is appropriate only if relative purchasing power parity is expected to hold in all future periods. If one of the currencies is strong in real terms and is expected to depreciate, as is the Australian dollar in this case, then PPP forecasts will be invalid.

Recall that the expected rate of real depreciation of the Australian dollar relative to the U.S. dollar is defined as the percentage change in the real exchange rate. The real exchange rate in this situation is the nominal exchange rate of USD/AUD multiplied by the Australian price level divided by the U.S. price level:

$$RS(t) = \frac{S(t)P(t, \text{AUD})}{P(t, \text{USD})}$$

Let the percentage change in the real exchange rate be $rs(t+1)$, and let the actual rates of inflation be $\pi(t+1, \text{USD})$ and $\pi(t+1, \text{AUD})$. Then

$$rs(t+1) = \frac{[S(t+1)P(t+1, \text{AUD})/P(t+1, \text{USD})]}{[S(t)P(t, \text{AUD})/P(t, \text{USD})]} - 1$$
$$= \frac{[1 + s(t+1)][1 + \pi(t+1, \text{AUD})]}{[1 + \pi(t+1, \text{USD})]} - 1$$

To generate expected rates of real depreciation, we can substitute expected values for actual values, using the expected rates of nominal appreciation derived in Exhibit 16.3 and the expected USD and AUD rates of inflation in Exhibit 16.1.

The calculations in Exhibit 16.6 indicate that the AUD is expected to weaken in real terms by 4.89% in the first year. The expected rate of real depreciation subsequently declines until it reaches 0.19% in year 9 and 0% in year 10. Exhibit 16.6 also shows the cumulative, expected percentage change in the real exchange rate. Given the nominal interest rates and the expected rates of inflation associated with two currencies, the financial markets are predicting that the Australian dollar will weaken in real terms relative to the U.S. dollar by 18.14% over the next 10 years. If the valuation of the project did not allow for this real depreciation of the Australian dollar, the value of the project would be severely overstated. Notice from the real interest rates in Exhibit 16.1 that the expected real depreciation of the AUD is associated with a currently high Australian real interest rate and a currently low U.S. real interest rate. Over time, the real interest differential is forecast to close as the Australian dollar weakens.

Chapter 9 notes that changes in real exchange rates often substantively affect the profitability of foreign operations. There is nothing in the present case that captures this important aspect of forecasting. This does not mean that the effect is unimportant. We merely left it out to simplify the discussion.

16.4 TERMINAL VALUE WHEN RETURN ON INVESTMENT EQUALS r_{WACC}

This section presents an alternative way to determine the terminal value of a project. In Chapter 15, we argued that terminal values in capital budgeting valuations should consider the rate at which the firm will grow in the long run and should discount the firm's growing free cash flow at the firm's cost of capital. If an explicit forecast for a 10-year horizon is available, the perpetuity formula for a cash flow growing at rate g, discounted at rate r, implies that the terminal value in year $t+10$, denoted $\text{TV}(t+10)$, is

$$\text{TV}(t+10) = \frac{\text{FCF}(t+11)}{(r - g)} \tag{16.37}$$

where $\text{FCF}(t+11) = \text{FCF}(t+10) \times (1 + g)$ is the expected value at time t of free cash flow in year $t+11$, which is g percent higher than the last explicit forecast. Notice that if we are doing a WACC analysis, we set $r = r_{\text{WACC}}$, whereas if we are doing an ANPV analysis, we set $r = r_A$, and we would handle the interest tax shields of perpetual debt separately.

Although calculating the terminal value in such a way is perfectly correct, it requires an understanding of the firm's nominal growth rate into the indefinite future. One assumption is that nominal growth will be only due to inflation because any real growth would require on-going investment by the firm. In such a situation, people often assume that the firm's capital expenditures are just equal to depreciation because the firm must be investing enough to keep its physical capital stock constant. To keep things simple, we adopt this convention below, in which case any investments are new investments. The firm's free cash flow (FCF) then equals its net operating profit (NOPLAT) minus new investments (INVEST). Recall from Chapter 15 that investments are in capital expenditures (CAPX) and changes in net working capital (ΔNWC).

Equilibrium Rate of Return on Investment

An alternative way of deriving terminal values involves developing explicit forecasts up to the point at which you think the firm's return on investment equals its weighted average cost of capital, r_{WACC}. This is a sensible condition because if the firm is earning a return on its investments that is larger than its cost of capital, either the firm should expand or, more likely, competitors will notice the above-average returns and enter the industry, thereby driving down the rate of return on invested capital. In the first part of this section, we assume that there is no expected inflation. Later, we add expected inflation to the analysis.

The Return on Investment and the Plowback Ratio
If there is no expected inflation, the **return on investment (ROI)** is simply the change in a firm's future operating profit divided by its investment:

$$\text{ROI}(t+1) = \frac{\text{NOPLAT}(t+1) - \text{NOPLAT}(t)}{\text{INVEST}(t)} \quad \text{(16.38)}$$

Because free cash flow is the difference between current net operating profit and investments, we can write

$$\text{FCF}(t) = \text{NOPLAT}(t) - \text{INVEST}(t) = \text{NOPLAT}(t) \times \left[1 - \frac{\text{INVEST}(t)}{\text{NOPLAT}(t)}\right] \quad \text{(16.39)}$$

In Equation (16.39), the ratio of investment to net operating profit is called the *reinvestment ratio*, or the **plowback ratio**, which we denote PB(t). The plowback ratio is the fraction of operating profits that management reinvests in the firm.

If we multiply both sides of Equation (16.38) by INVEST(t) and divide both sides by NOPLAT(t), we find

$$\text{ROI}(t+1) \times \frac{\text{INVEST}(t)}{\text{NOPLAT}(t)} = \frac{\text{NOPLAT}(t+1) - \text{NOPLAT}(t)}{\text{NOPLAT}(t)} \quad \text{(16.40)}$$

The left-hand side of Equation (16.40) is the return on investment multiplied by the plowback ratio, and the right-hand side is the rate of growth of the cash flows:

$$\text{ROI}(t+1)\,\text{PB}(t) = g$$

This makes perfect sense. A firm's income grows faster, the higher the rate of return on its investments, and the more of its previous income the firm chooses not to pay its shareholders.

The Terminal Value Calculation

If we substitute for FCF $(t+1)$ in Equation (16.37) using Equation (16.39), we find

$$\text{TV}(t+10) = \frac{\text{NOPLAT}(t+11) \times [1 - \text{PB}(t+11)]}{r - g} \qquad \textbf{(16.41)}$$

From Equation (16.40), $[1 - \text{PB}] = [1 - g/\text{ROI}] = [\text{ROI} - g]/\text{ROI}$. A key insight is that if a firm has exhausted all its positive NPV projects, then the firm's return on investment will just equal its cost of capital. Thus, we should set $\text{ROI} = r$, and by substituting into the expression for terminal value in Equation (16.41), we find

$$\text{TV}(t+10) = \frac{\text{NOPLAT}(t+11)\left(\dfrac{r - g}{r}\right)}{(r - g)} = \frac{\text{NOPLAT}(t+11)}{r} \qquad \textbf{(16.42)}$$

This expression looks like a no-growth perpetuity, but NOPLAT and FCF are actually growing at rate g.

Example 16.4 Conundrum Corporation's Terminal Value

Assume that the Conundrum Corporation has a weighted average cost of capital of 10%, and suppose that the final year of a 10-year forecast for Conundrum's NOPLAT is $100 million. If Conundrum just invests enough to offset depreciation, we know free cash flow in year $t+10$ will also be $100 million. With no inflation and no real growth, $100 million will also be the forecast of free cash flow in all future periods. Hence, the terminal value in year $t+10$ of future cash flows beginning in year $t+11$ is

$$\text{TV}(t+10) = \frac{\$100\,\text{m}}{1.1} + \frac{\$100\,\text{m}}{1.1^2} + \frac{\$100\,\text{m}}{1.1^3} + \ldots = \frac{\$100\,\text{m}}{0.1} = \$1,000\,\text{million}$$

Now, suppose that every year, Conundrum reinvests 20% of its net operating profits in new projects. What is Conundrum's growth rate if these new investment projects are zero NPV?

Because $\text{ROI} = r$ when projects are zero NPV, we use Equation (16.40) to find Conundrum's growth rate:

$$g = r \times \text{PB} = 10\% \times 20\% = 2\%$$

We can find the new terminal value in two ways. We know that Conundrum invests 20% of NOPLAT or $20 million. Hence, the last explicit forecast is $\text{FCF}(t+10) = \$80$ million. Free cash flow in year $t+11$ will be 2% higher because the firm is growing at 2%, so $\text{FCF}(t+11) = \$80$ million $\times 1.02 = \$81.6$ million. Equation (16.37) indicates that the terminal value is a perpetuity starting at $81.6 million, growing at 2%, and discounted at 10%. Thus,

$$\text{TV}(t+10) = \frac{\$81.6\,\text{million}}{0.10 - 0.02} = \$1,020\,\text{million}$$

Alternatively, we can calculate the terminal value using Equation (16.42). In year $t+11$, NOPLAT will be 2% higher than year $t+10$'s $100 million, or $102 million. Thus,

$$\text{TV}(t+10) = \frac{\$102 \text{ million}}{0.10} = \$1{,}020 \text{ million}$$

Notice that the terminal values are the same; furthermore, they are $20 million higher than the no-growth terminal value. This is exactly what is required for firm value not to change because $20 million of free cash flow was invested in year $t+10$.

Terminal Value with Perpetual Growth and with Expected Inflation

In the Conundrum Corporation example, there is no expected inflation. When there is expected inflation, we must modify not only the cost of capital, but also the terminal value calculation in Equation (16.42). The easiest way to do this is to recognize that the firm's nominal required rate of return can be decomposed, as in the Fisher equation, into a required real return and expected inflation:

$$1 + R_{\text{WACC}} = (1 + r_{\text{WACC}}) \times (1 + \pi^e) \qquad \textbf{(16.43)}$$

In Equation (16.43), R_{WACC} is the firm's nominal weighted average cost of capital, r_{WACC} is the firm's real weighted average cost of capital, and π^e is the expected rate of inflation. Let's assume that the expected rate of inflation is 5%, and we continue to assume that the real weighted average cost of capital is 10%. Then, the nominal weighted average cost of capital is 15.5%, since $(1.155) = (1.10) \times (1.05)$.

Exhibit 16.7 demonstrates what happens when there is inflation and growth using the Conundrum parameters as examples. In Panel A, the plowback ratio is 0, so there are no net investments. All nominal cash flows grow at the 5% rate of inflation. The terminal value in year $t+10$ is again $1,000 million because

$$\text{TV}(t+10) = \frac{\$105 \text{ m}}{1.155} + \frac{\$110.3 \text{ m}}{1.155^2} + \ldots = \frac{\$105 \text{ m}}{0.155 - 0.05} = \$1{,}000 \text{ million}$$

In Panel B, the firm has a plowback ratio of 20%, and it earns a 10% real return on investment. This means that real growth, g, will be $0.02\% = 20\% \times 10\%$. NOPLAT will be 2% higher each year in the future because more real goods are being produced, but each of those goods will be sold at 5% higher prices. Hence, all of the firm's nominal cash flows will grow at $7.10\% = (1.02) \times (1.05) - 1$. The terminal value in year $t+10$ can be found by discounting the forecasts of growing free cash flow with the nominal weighted average cost of capital:

$$\text{TV}(t+10) = \frac{\$85.7 \text{ m}}{1.155} + \frac{\$91.8 \text{ m}}{1.155^2} + \frac{\$98.3 \text{ m}}{1.155^3} + \ldots = \frac{\$85.7 \text{ m}}{0.155 - 0.071} = \$1{,}020 \text{ million}$$

where $85.7 million $= (\$100 \text{ million} - \$20 \text{ million}) \times 1.071$. Notice that this terminal value is $20 million higher than in the no plowback case exactly because the firm earns the required real rate of return on its investment, 10%, and $20 million was taken from year $t+10$ to begin the growth process. The overall value of the firm has not changed. The $20 million taken from free cash flow in year $t+10$ is returned in the present value of future free cash flows. Thus, when there is inflation and growth, we can find the terminal value by taking the terminal value with no net investment and adding the value of zero NPV investments made in year $t+10$:

$$\text{TV}(t+10) = \frac{\text{NOPLAT}(t+10) \times (1 + \pi^e)}{R_{\text{WACC}} - \pi^e} + \text{Net investments } (t+10)$$

The *Point–Counterpoint* explores Panel C of Exhibit 16.7.

Exhibit 16.7   Terminal Values in Year 10 with Inflation and Growth

Panel A: Terminal Value with Inflation

Inputs			Year					
			10	11	12	13	14	15
Inflation	5%	NOPLAT	100.0	105.0	110.3	115.8	121.6	127.6
Required Real ROI	10%	Net Investment	0.0	0.0	0.0	0.0	0.0	0.0
Actual Real ROI	10%	Free Cash Flow	100.0	105.0	110.3	115.8	121.6	127.6
Plowback Ratio	0%	NPV	100.0	90.9	82.6	75.1	68.3	62.1
Nominal WACC	15.5%							
		NOPLAT Growth		5.0%	5.0%	5.0%	5.0%	5.0%
		FCF Growth		5.0%	5.0%	5.0%	5.0%	5.0%
		Real Growth		0.0%	0.0%	0.0%	0.0%	0.0%
	Terminal Value in Year 10		**1000**					

Panel B: Terminal Value with Growth and Inflation

Inputs			Year					
			10	11	12	13	14	15
Inflation	5%	NOPLAT	100.0	107.1	114.7	122.8	131.6	140.9
Required Real ROI	10%	Net Investment	20.0	21.4	22.9	24.6	26.3	28.2
Actual Real ROI	10%	Free Cash Flow	80.0	85.7	91.8	98.3	105.3	112.7
Plowback Ratio	20%	NPV	80.0	74.2	68.8	63.8	59.1	54.8
Nominal WACC	15.5%							
		NOPLAT Growth		7.1%	7.1%	7.1%	7.1%	7.1%
		FCF Growth		7.1%	7.1%	7.1%	7.1%	7.1%
		Real Growth		2.0%	2.0%	2.0%	2.0%	2.0%
	Terminal Value in Year 10		**1020**					

Panel C: Terminal Values in Year 10 Under Different ROIs and Plowback Ratios

		Actual Real ROI						
		0.07	**0.08**	**0.09**	**0.1**	**0.11**	**0.12**	**0.13**
	0	1,000	1,000	1,000	1,000	1,000	1,000	1,000
	0.05	988	994	999	1,005	1,011	1,017	1,023
	0.10	975	986	998	1,010	1,022	1,035	1,048
Plowback Ratio	0.15	960	977	996	1,015	1,035	1,055	1,076
	0.20	943	968	993	1,020	1,048	1,078	1,109
	0.25	925	956	990	1,025	1,063	1,104	1,147
	0.30	905	943	985	1,030	1,079	1,133	1,192

POINT–COUNTERPOINT

Does Faster Growth Lead to More Value?

It's springtime in Washington, D.C., and the Handel brothers are walking with Suttle by the Potomac River enjoying the cherry blossoms. Out of the blue, Ante says, "You know, Freedy, I think we've got to invest more of our retirement portfolio in growth companies. Faster growth leads to higher profits, and higher profits provide better returns. That means we'll be able to retire earlier."

Freedy is a little taken aback because his mind is on the cherry trees, but he manages to reply, "Ante, you just don't get it, do you? Managers who increase growth are only

wasting shareholders' cash. I like nice stable cash flows from value companies. They have great products and good profits, and they return lots of cash to shareholders. Growth just destroys value."

Ante argues, "Well, in Bekaert and Hodrick's book, faster growth translates into higher terminal values because you're dividing the last forecast of free cash flow by $r - g$. A larger g makes the denominator smaller, and that makes the terminal value bigger, so faster growth leads to more value."

Freedy counters, "Those investments for growth came from free cash flow that could have been paid out to shareholders. I want money now, not some promise of money in the future that never materializes."

Suttle knows that an argument is brewing and says, "When we get back to the hotel, let's revisit the part in Bekaert and Hodrick's book where they discuss growth and terminal values. I think it's Example 16.4." Later, Suttle shows the brothers that real growth depends on the plowback ratio multiplied by the actual real rate of return on investment.

"So, I'm right!" exclaims Ante. "If a firm invests more, it grows faster." Freedy, red in the face, argues, "But the firm is worth less because they aren't paying out the money now."

At this point, Suttle says, "Ante, you're right that a higher plowback ratio leads to more growth, and Freedy, you're wrong that the firm can't be worth more. But, Ante, you're wrong, too. Whether growth increases firm value or not depends on the firm's return on investment relative to its WACC. Look at Panel C of Exhibit 16.7. The different cells refer to Conundrum's terminal value depending on their plowback ratio and their actual real return on investment. Remember, Conundrum's real cost of capital was 10%. The Exhibit clearly shows that plowing back higher percentages of NOPLAT decreases value if the firm earns less than its cost of capital, while value increases if the firm earns more than the cost of capital."

"The interesting column is when Conundrum's return on investment just equals its cost of capital. Suppose Conundrum changes its plowback ratio from 20% to 30%. Equation (16.40) indicates that the firm's real growth rate will increase from 2% to 3%. So, Ante is right, more plowback leads to more growth. The additional investment in year $t+10$ is 10% of $100 million, or $10 million. Thus, free cash flow in year $t+10$ falls from $80 million to $70 million. The terminal value calculation is now done by recognizing that free cash flow will be growing at 8.15% $(1.03 \times 1.05 - 1)$ and is discounted at 15.5%:

$$\text{Terminal value in year } t\text{+10} = \frac{\$70 \text{ million} \times 1.0815}{0.155 - 0.0815} = \$1,030 \text{ million}$$

"Notice that this is $10 million higher than before," says Suttle, "which is the amount of the additional investment."

After Suttle presents his analysis, he says, "Growth does lead to increases in value, but only if the real return on investment is larger than the real WACC does the firm's value increase by more than the amount of the investment."

16.5 TAX SHIELDS ON FOREIGN CURRENCY BORROWING

When a corporation borrows foreign currency, it gets an interest deduction just as if it borrows in the home currency. But when the loan is repaid, the corporation may experience either a capital gain (if the home currency strengthens in value relative to the foreign currency) or capital loss (if the home currency weakens relative to the foreign currency). The capital gains are treated as income to the firm and are subject to tax. The capital losses are deductible for tax purposes and provide additional tax shields. This section first explores the theory associated with these capital gains and losses. It then analyzes the borrowing possibilities of Banana Computers.

The Tax Implications of Borrowing in a Foreign Currency

Suppose a U.S. corporation borrows foreign currency at time t for 1 year. Let the foreign currency principal and interest be denoted $D(FC)$ and $i(FC)$, respectively. If the exchange rate, $S(t)$, is dollars per foreign currency, the dollar value of the principal is $S(t) \times D(FC)$. In 1 year, the firm will repay the foreign currency principal plus interest, and it will be able to deduct the dollar value of the actual interest paid. A weakening of the dollar increases the amount of interest paid, and a strengthening of the dollar decreases the amount of interest paid. Thus, the actual interest deduction at time $t+1$ will be $S(t+1) \times i(FC) \times D(FC)$.

Changes in the exchange rate will also affect the dollar value of the repayment of the foreign currency principal, which is $S(t+1) \times D(FC)$ dollars. If the dollar has strengthened versus the foreign currency, $S(t+1) < S(t)$, in which case the corporation will repay fewer dollars of principal than it borrowed. The difference between the dollar amount borrowed and the dollar amount repaid, $[S(t) - S(t+1)] \times D(FC)$, is the corporation's capital gain. Because capital gains are income to the firm, the firm will have to pay income tax on this capital gain.

Conversely, if the dollar has weakened versus the foreign currency, $S(t+1) > S(t)$, and the corporation repays $S(t+1) \times D(FC)$ dollars, which is more dollars than it borrowed. The difference between the dollar amount repaid and the dollar amount borrowed, $[S(t+1) - S(t)] \times D(FC)$, is the firm's capital loss. The firm will be able to deduct that loss from its income, which allows the firm to pay less income tax.

Because interest rates differ across countries, there are expected changes in exchange rates, and consequently, there are expected capital gains and losses when borrowing foreign currencies. The expected taxes on capital gains are necessary to prevent the firm from having an incentive to borrow in high interest rate currencies to get larger interest tax shields. Because high interest rate currencies are expected to depreciate relative to the home currency, the borrower expects to have a capital gain on the repayment of principal. The capital gain tax offsets the higher interest tax shield and prevents the existence of a tax incentive to borrow in high interest rate currencies.

The next section presents an analysis of a case in which Banana Computers is confronted with alternative foreign currency borrowing opportunities. Banana uses an ANPV analysis to find the best one.

Foreign Currency Borrowing by Banana Computers

If projects are mutually exclusive, ANPV analysis dictates that the firm should accept the project with the largest ANPV. One situation in which this type of analysis arises is when an importer is buying goods with subsidized financing provided either by the exporter or by the exporter's government. If the imported goods are really the same from country to country, the importer's problem is just to find the best financing. An ANPV analysis of the financing takes account of the interest tax shields as well as any capital gain taxes or capital loss subsidies that arise from changes in exchange rates. This section provides a concrete demonstration of these effects.

Banana's Borrowing Possibilities

Suppose Banana Computers, a U.S. company, wants to buy some computer hard drives from either a German manufacturer or a Japanese manufacturer. From Banana's perspective, the hard drives are the same, but the financing is different. The German company has arranged for Banana to borrow EUR300 million for 8 years at an annual interest rate of 3.5%. This rate is below the 8-year, risk-free euro interest rate of 5%. The Japanese manufacturer has also arranged for Banana to borrow JPY36,000 million for 8 years at an even lower interest rate of 1.5%.

The 8-year, risk-free yen interest rate is 2.5%. At the current exchange rate of JPY120/EUR, the principals on the loans are identical because

$$(\text{JPY120/EUR}) \times \text{EUR300 million} = \text{JPY36,000 million}$$

Both exporters require repayment with equal annual installments. Amortization is the process of repaying the principal on a long-term debt over time. Because interest is paid only on outstanding principal, amortizing a loan with equal annual payments means that the borrower pays more interest in the earlier years of the loan and more principal in the later years.[6]

If the hard drives are identical, which foreign loan should Banana take? Alternatively, should Banana borrow in dollars at its market rate of 6% when the risk-free dollar interest rate is 4%? At the spot exchange rate of USD1.0909/EUR, the dollar principal would be

$$(\text{USD1.0909/EUR}) \times \text{EUR300 million} = \text{USD327.27 million}$$

Exhibits 16.8 through 16.10 present the ANPV cash flow analyses associated with the dollar loan, the euro loan, and the yen loan, respectively.

The Dollar Loan

The dollar loan is the most straightforward and is the benchmark to which the other loans can be compared. Exhibit 16.8 indicates that eight annual payments of USD52.70 million are required to repay the USD327.27 million principal at an interest rate of 6%. Because interest is paid only on the outstanding balance, the first interest payment is

$$0.06 \times \text{USD327.27 million} = \text{USD19.64 million}$$

By year 8, only USD49.72 million of principal is outstanding, so the last interest payment is

$$0.06 \times \text{USD49.72 million} = \text{USD2.98 million}$$

The ANPV analysis values the expected after-tax dollar cash flows that are received or paid in each year. In the first year, Banana receives the $327.27 million as the principal of the loan. In future years, the cash outflow is the sum of the interest paid and the principal repaid

Exhibit 16.8 The Value of a Dollar Loan

				Years in the Future					
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Dollar Payments on the USD327.27 Million Loan									
Interest @ 6%		19.64	17.65	15.55	13.32	10.96	8.45	5.80	2.98
Principal		33.07	35.05	37.15	39.38	41.76	44.25	46.91	49.72
Total		52.70	52.70	52.70	52.70	52.70	52.70	52.70	52.70
Expected Dollar Cash Flows Associated with the USD Loan									
Interest		−19.64	−17.65	−15.55	−13.32	−10.96	−8.45	−5.80	−2.98
Principal	327.27	−33.07	−35.05	−37.15	−39.38	−41.75	−44.25	−46.91	−49.72
Interest Tax Shield		6.68	6.00	5.29	4.53	3.73	2.87	1.97	1.01
Dollar Cash Flows	327.27	−46.03	−46.70	−47.42	−48.17	−48.98	−49.83	−50.73	−51.69
NPV of Dollar Cash Flows @ 6%	26.42								

Notes: All cash flows are in millions of dollars and are rounded to two decimal places. Inflows are positive, and outflows are negative.

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[6]In Microsoft Excel, the command PMT(*rate, nper, pv, fv, type*) returns the value of an annual payment associated with borrowing an amount, *pv*, at an interest rate, *rate*, for *nper* years with future value *fv*. *type* indicates whether the payments are at the beginning or the end of the year. The commands IPMT and PPMT provide the breakdown of the payment into interest and principal.

minus the interest tax shield. With a corporate tax rate of 34%, the deductibility of interest paid provides an interest tax shield in the first year equal to

$$0.34 \times \text{USD19.64 million} = \text{USD6.68 million}$$

The amount by which the present value of the future after-tax payments associated with the loan is less than the value of the principal borrowed is the ANPV of the loan. These debt cash flows should be discounted at Banana's market-debt interest rate of 6%. Exhibit 16.8 indicates that the ability to borrow USD327.27 million at 6% is worth USD26.42 million.

The Euro and Yen Loans

Exhibit 16.9 presents the analysis of the euro loan. We see that eight annual payments of EUR43.64 million are required to amortize the EUR300 million principal at an interest rate of 3.5%. Because interest is paid on the outstanding balance, the first interest payment is

$$0.035 \times \text{EUR300 million} = \text{EUR10.50 million}$$

By year 8, only EUR42.17 million of principal is outstanding, so the final interest payment is

$$0.035 \times \text{EUR42.17 million} = \text{EUR1.48 million}$$

Exhibit 16.10 presents the analysis of the yen loan. Here, eight annual payments of JPY4,809.02 million are required to amortize the JPY36,000 million principal at an interest rate of 1.5%. The first interest payment is

$$0.015 \times \text{JPY36,000 million} = \text{JPY540 million}$$

In year 8, the outstanding principal is JPY4,737.96 million, so the final interest payment is

$$0.015 \times \text{JPY4,737.96 million} = \text{JPY71.07 million}$$

Comparing the Foreign Currency Loans

Because Banana Computers is a U.S. company, it can compare the values of the two subsidized deals by converting the expected future foreign currency cash flows into expected future dollars, using expected future exchange rates. Exhibits 16.9 and 16.10 use uncovered

Exhibit 16.9 The Value of a Subsidized Euro Loan

	Years in the Future								
	0	1	2	3	4	5	6	7	8
Euro Payments on the EUR300 Million Loan									
Interest @ 3.5%		10.50	9.34	8.14	6.90	5.61	4.28	2.90	1.48
Principal		33.14	34.30	35.50	36.75	38.03	39.36	40.74	42.17
Total		43.64	43.64	43.64	43.64	43.64	43.64	43.64	43.64
Expected USD/EUR from Interest Rate Parity with i(USD) = 4% and i(EUR) = 5%									
Exchange Rate	1.0909	1.0805	1.0702	1.0600	1.0499	1.0399	1.0300	1.0202	1.0105
Expected Dollar Cash Flows Associated with the Euro Loan									
Interest		−11.35	−10.00	−8.63	−7.24	−5.83	−4.41	−2.96	−1.49
Principal	327.27	−35.81	−36.71	−37.63	−38.58	−39.55	−40.55	−41.56	−42.61
Interest Tax Shield		3.86	3.40	2.93	2.46	1.98	1.50	1.01	0.51
Capital Gains Subsidy or Tax		−0.12	−0.24	−0.37	−0.51	−0.66	−0.81	−0.98	−1.15
Dollar Cash Flows	327.27	−43.42	−43.55	−43.70	−43.87	−44.06	−44.27	−44.50	−44.75
NPV of Dollar Cash Flows @ 6%	54.31								

Notes: All cash flows are in millions and are rounded to two decimal places. In the top panel, the currency is the euro; in the bottom panel, it is the dollar.

Exhibit 16.10 The Value of a Subsidized Yen Loan

	Years in the Future								
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Yen Payments on the JPY36,000 Million Loan									
Interest @ 1.5%		540.00	475.96	410.97	345.00	278.04	210.07	141.09	71.07
Principal		4,269.02	4,333.06	4,398.06	4,464.03	4,530.99	4,598.95	4,667.94	4,737.96
Total		4,809.02	4,809.02	4,809.02	4,809.02	4,809.02	4,809.02	4,809.02	4,809.02
Expected JPY/USD from Interest Rate Parity with i(USD) = 4% and i(JPY) = 2.5%									
Exchange Rate	110.00	108.41	106.85	105.31	103.79	102.29	100.82	99.36	97.93
Expected Dollar Cash Flows Associated with the Yen Loan									
Interest		−4.98	−4.45	−3.90	−3.32	−2.72	−2.08	−1.42	−0.73
Principal	327.27	−39.38	−40.55	−41.76	−43.01	−44.29	−45.62	−46.98	−48.38
Interest Tax Shield		1.69	1.51	1.33	1.13	0.92	0.71	0.18	0.25
Capital Gains Subsidy or Tax		0.19	0.39	0.61	0.83	1.06	1.29	1.54	1.80
Dollar Cash Flows	327.27	−42.47	−43.10	−43.73	−44.38	−45.03	−45.70	−46.37	−47.05
NPV of Dollar Cash Flows @ 6%	50.75								

Notes: All cash flows are in millions and are rounded to two decimal places. In the top panel, the currency is the yen; in the bottom panel, it is the dollar.

interest rate parity, calculated using the risk-free interest rates, to generate forecasts of future exchange rates. It is assumed that the term structures of interest rates are flat in each of the currencies. In Exhibit 16.9, the spot exchange rate of dollars per euro is USD1.0909/EUR, and the forecast of the exchange rate k years in the future is

$$E_t[S(t+k)] = (\text{USD1.0909/EUR}) \times [1.04/1.05]^k$$

Because the dollar interest rate is less than the euro interest rate, the dollar is expected to appreciate relative to the euro. The expected dollar appreciation implies that capital gains are expected on the repayment of the euro principal. The capital gain arises because it takes fewer dollars to repay the euro principal, which increases the income of Banana Computers. The associated capital gains taxes reduce the value of the deal.

In Exhibit 16.10, the spot exchange rate of yen per dollar is JPY110/USD, and the forecast of the exchange rate k years in the future is

$$E_t[S(t+k)] = (\text{JPY110/USD}) \times [1.025/1.04]^k$$

Because the yen interest rate is less than the dollar interest rate, the dollar is expected to weaken relative to the yen. Hence, Banana Computers expects to pay more dollars to repay the yen principal than the amount of dollars it borrows after the conversion of the yen principal at the current exchange rate. Banana therefore expects to take capital losses on the repayment of the yen principal. Because these expected capital losses are tax deductible, they enhance the value of the deal.

With a U.S. corporate tax rate of 34%, the interest tax shield is 34% of the expected dollar interest paid on either the euro loan or the yen loan, just as in the case of a dollar loan. For example, in year 1, interest on the euro loan is €10.50 million, and the expected spot rate is $1.0805/€. Expected dollar interest is therefore $1.0805/€ × €10.5 million = $11.35 million. The interest tax shield is 0.34 × $11.35 million = $3.86 million. In the case of the euro loan, the capital gains tax is 34% of the difference between the dollar value of the principal borrowed and the dollar value of the principal repaid. For example, the principal repaid in year 1 is €33.14 million, and the expected capital gains tax is $0.34 \times €33.14 \times \left(\dfrac{\$1.0909}{€} - \dfrac{\$1.0805}{€} \right) = \$0.12$ million. For the yen loan, the tax deductibility of the capital

loss provides a subsidy of 34% of the difference between the dollar value of the principal repaid and the dollar value of the principal borrowed.

As in the case of the dollar loan, the ANPV analysis takes the present value of the expected after-tax dollar cash flows that are received or paid in each year using the discount rate of 6% because the future expected dollar cash flows have the same risk characteristics as dollar debt. In the first year, Banana receives the $327.27 million as the principal of the loan. For foreign currency loans, the dollar cash outflow in future years is the sum of the interest paid and principal repaid, minus the interest tax shield and plus any capital gains tax or minus any capital-loss subsidy. The amount by which the present value of the future payments is less than the value of the principal borrowed is the ANPV of the loan.

Exhibit 16.9 indicates that the ANPV of the euro loan is $54.31 million, whereas Exhibit 16.10 indicates that the ANPV of the yen loan is $50.75 million. Both of these dominate the dollar loan because they are subsidized. Because only one loan can be taken, Banana should take the euro loan. By taking the euro loan, Banana adds $54.31 million to the value of the corporation.

16.6 CONFLICTS BETWEEN BONDHOLDERS AND STOCKHOLDERS

Whenever a firm issues debt, potential conflicts of interest arise between the bondholders and the stockholders. These conflicts are one of the difficult-to-quantify aspects of the costs of **financial distress**. Rather than attempt to quantify the nature of these costs, we merely examine how they arise in an international context. You should remember that the managers of a firm are assumed to be acting in the interests of the shareholders—that is, maximizing shareholder value. This is the natural perspective because the shareholders are the ultimate owners of the firm, and the managers report to the board of directors, who represent the shareholders.

The Incentive to Take Risks

The first conflict between bondholders and stockholders arises because the managers of a firm that is near bankruptcy, who are acting in the interests of the stockholders, have an incentive to invest in very risky projects. The projects might even be ones that have a negative net present value.

To understand these incentives, consider a U.S. firm with debt that has a face value of $500 and that is trying to choose between two mutually exclusive international investment projects. The variance of the return on one project is low, whereas the variance of the return on the other is high. For ease of exposition, assume that there are only two possible states of the world that affect the projects: Either the foreign currency will appreciate versus the dollar, implying that the projects will be successful, or the foreign currency will depreciate, and the projects will provide poor returns. Assume that each of the two possible states of the world has a 50% possibility. To simplify the arguments, we ignore discounting throughout.

The Low-Variance Project
If the firm accepts the low-variance project, the value of the firm, its equity, and its bonds in the different states of the world can be summarized as follows:

LOW-VARIANCE PROJECT				
	Probability	Value of Firm	Value of Equity	Value of Bonds
Foreign Currency Depreciation	0.5	$500	0	$500
Foreign Currency Appreciation	0.5	$600	$100	$500

If the firm accepts the low-variance project, the expected value of the firm is

$$0.5 \times \$500 + 0.5 \times \$600 = \$550$$

The cash flows from the project are sufficient to cover the firm's outstanding debt in either state of the world, so the debt is riskless. Because the firm always generates enough cash to repay the debt, the debt is worth its face value of $500 whether the dollar appreciates or depreciates. Equity, on the other hand, will be worthless if the dollar strengthens because the firm generates only enough funds to repay the bondholders. However, the equity will be worth $100 if the dollar weakens. The expected value of equity is therefore

$$0.5 \times \$0 + 0.5 \times \$100 = \$50$$

The High-Variance Project

If the firm takes the high-variance project, the values of the firm, its equity, and its debt can be described as follows:

HIGH-VARIANCE PROJECT				
	Probability	Value of Firm	Value of Equity	Value of Bonds
Foreign Currency Depreciation	0.5	$400	0	$400
Foreign Currency Appreciation	0.5	$650	$150	$500

If the firm undertakes the high-variance project, the expected value of the firm is

$$0.5 \times \$400 + 0.5 \times \$650 = \$525$$

If the dollar strengthens, though, the cash flows from the project will be insufficient to cover the firm's $500 outstanding debt, and the value of the debt will be $400. If the dollar depreciates, the full value of the debt can be repaid, and it will be worth $500. The expected value of debt is therefore

$$0.5 \times \$400 + 0.5 \times \$500 = \$450$$

On the other hand, equity will again be worthless if the dollar strengthens, but equity will be worth $150 if the dollar weakens. The expected value of equity is therefore

$$0.5 \times \$0 + 0.5 \times \$150 = \$75$$

Clearly, because the two projects are mutually exclusive, if the firm's managers act in the interest of the stockholders, they will undertake the inferior, high-variance project because it maximizes the value of the firm's equity. The key insight is that because the firm is currently levered, the stockholders gain when the dollar weakens but they do not lose when the dollar strengthens. By taking the high-variance project, the managers of the firm transfer $25 of value from the bondholders to the stockholders. Notice, though, the managers also destroy an additional $25 of firm value. By accepting the wrong project from the perspective of the firm as a whole, the managers are said to have engaged in **asset substitution**.

The Underinvestment Problem

If a firm is near bankruptcy, managers who act in the interest of stockholders often do not have an incentive to make investments that would increase the overall value of the firm because too much of the increase in the firm's value is captured by the existing bondholders. This is known as **underinvestment**. To understand this scenario, examine the following situations.

A Firm Without a New Project

Suppose that a firm has outstanding bonds with face value of $500, and its cash flows without a new project are as follows:

		FIRM WITHOUT A NEW PROJECT		
	Probability	Value of Firm	Value of Equity	Value of Bonds
Dollar Appreciation	0.5	$400	0	$400
Dollar Depreciation	0.5	$600	$100	$500

The expected value of the firm's assets is

$$0.5 \times \$400 + 0.5 \times \$600 = \$500$$

Because the firm does not have enough to repay the bonds in the bad state of the world, the expected value of the firm's bonds is

$$0.5 \times \$400 + 0.5 \times \$500 = \$450$$

As the residual claimants to the firm's cash flows, the expected value of the equity is

$$0.5 \times \$0 + 0.5 \times \$100 = \$50$$

A Firm with a New Project

Now, suppose that the managers of this firm have an opportunity to invest in a project that costs $100 of equity. Suppose that the cash flows of the firm with the new project would be as follows:

		FIRM WITH A NEW PROJECT		
	Probability	Value of Firm	Value of Equity	Value of Bonds
Dollar Appreciation	0.5	$500	0	$500
Dollar Depreciation	0.5	$760	$260	$500

If the firm accepts the project, the expected value of the firm increases by $130, to

$$0.5 \times \$500 + 0.5 \times \$760 = \$630$$

Because the firm now has enough resources to repay the bonds, the expected value of the firm's bonds is $500:

$$0.5 \times \$500 + 0.5 \times \$500 = \$500$$

The stockholders remain the residual claimants to the firm's cash flows, and the expected value of the equity of the firm is

$$0.5 \times \$0 + 0.5 \times \$260 = \$130$$

What has been accomplished by investing the additional $100 of shareholders' equity? First, the value of the firm has increased by $130. Consequently, this is a positive NPV project for the firm as a whole. But will the stockholders want the managers to invest in this project? The answer is no.

Earlier, we determined that the value of equity without an investment in the new project is $50. With the new project, equity value rises to $130. Hence, from the stockholders' perspective, they invest $100, but they see their equity value increase by only $80. The problem is, of course, that the existing bondholders of the firm are reaping a substantial benefit from the new project. Their bonds increase in value by $50, from $450 to $500.

In this situation, as in the previous section, managers who are acting in the interests of stockholders and are maximizing shareholder value do not make a correct investment decision. If the manager does not take this investment project, this is a true cost of financial distress because the project is positive NPV for the firm as a whole.

Underinvestment in Emerging Market Crises

Economists think that the problems associated with underinvestment partially explain the prolonged nature of the Debt Crisis in the 1980s. The governments of emerging-market countries with large outstanding foreign debts could not credibly commit not to tax the positive returns to investments made in their countries. Thus, because managers of firms perceived that too much of the return on investment would be captured by the governments to repay the foreign loans due to the debt overhang, no one wanted to invest in these countries. Without investments, the countries could not grow and could not generate enough tax revenues to allow the governments to repay the foreign debts. Debt forgiveness, in the form of the Brady Plan, helped to overcome the problems and allowed growth to resume.

Other Managerial Problems Caused by Financial Distress

The previous section demonstrates that stockholders might not want to contribute new equity to a project that has a positive NPV if too much of the benefit of the new project will go to existing bondholders. A natural counterpart to this idea is that stockholders would like to see cash distributed from the firm when it is near financial distress. Of course, when cash is distributed from the firm, the market value of the firm•s stock will fall, but it will fall less than the value of any cash dividends because bondholders will suffer some of the loss, as well.

The managers of a firm that is close to financial distress also have an incentive to misrepresent the financial condition of the firm to keep creditors at bay. The firm may be forced to cut its capital expenditures by doing less maintenance than is desirable, and its research and development expenditures may be slashed. Such actions buy time for the current managers, but they may destroy the value of the firm•s assets.

16.7 INTERNATIONAL DIFFERENCES IN ACCOUNTING STANDARDS

Historically, international valuations were often complicated because accounting standards differed significantly across countries. However, over the past 10 years, a large number of countries (well over 80) have endorsed **international financial reporting standards (IFRS)**, which were developed by the International Accounting Standards Board.[7] While a number of firms have used IFRS voluntarily for quite a while, mandatory adoption started in a large number of countries, including the European Union (EU), in 2005. Adoption rates differ across countries but now exceed over 90% of the firms in many developed and some emerging countries. Because mandatory adoption of IFRS is limited to consolidated accounts and smaller firms often get an exemption, some firms in countries with mandatory IFRS adoption continue to report under local accounting standards. Nevertheless, IFRS opens up the possibility of providing investors and analysts with transparent financial statements that can be easily compared across countries. While the United States has not formally adopted IFRS yet, the U.S. Securities and Exchange Commission (SEC) has, since 2009, allowed cross-listed companies to either use U.S. **generally accepted accounting principles (GAAP)** or IFRS. Moreover, in 2008, it set out a roadmap for possible IFRS adoption by U.S. publicly traded companies to be completed by 2015 for large companies and by 2017 for small companies.

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[7]For a discussion of the key differences between U.S. GAAP and IFRS, see Chapter 21 of Koller et al. (2005).

Before jumping for joy and thinking that comparisons across countries will be easy in the future, it is important to think about some issues raised by Ball (2006), who argues, "All accounting accruals (versus simply counting cash) involve judgments about future cash flows. Consequently, there is much leeway in implementing accounting rules. . . . Achieving uniformity in accounting standards seems easy in comparison with achieving uniformity in actual reporting behavior" (p. 27). Ball notes that while many countries use the metric system, the weight of the butcher's thumb on the scale differs across countries and is constrained by the eye of the customer, the butcher's concern for reputation, and the monitoring mechanisms of state and private systems. So too will it be with international accounting. The roles of auditors, regulators, courts, boards, analysts, rating agencies, the press, and others who use financial information in overseeing the financial reporting of corporations differ across countries and over time in a specific country. Hence, it is unlikely that uniformity in accounting rules will be followed quickly by uniformity in accounting practice. Hail et al. (2010), in an exhaustive survey on IFRS, also conclude that diversity in accounting standards may be the expected outcome of diversity in the institutional infrastructures of different countries.

Empirical Effects of IFRS Adoption

Despite Ball's (2006) criticism, a large literature has tried to uncover the benefits and costs of IFRS adoption. First, while IFRS should be expected to harmonize accounting standards across countries, as Ball argues, differences in accounting practices will remain and comparability may not be perfect. For U.S. firms, it is often argued that U.S. GAAP and IFRS are not so different to begin with and have been converging over time. Yet, some recent studies document rather large differences in terms of important financial results. For example, Henry et al. (2009) claim that an important economic concept like the return on equity may substantially differ across the two systems for a large set of firms. Second, better accounting standards may lead to more and better quality disclosure of information about the firm's projects and economic earnings. This, in turn, should be associated with positive market outcomes, such as improved liquidity (as investors feel more secure trading the stock) and larger investments by foreign investors. Both effects may induce lower costs of capital for the firm. In their survey of the empirical literature, Hail et al. (2010) claim that these effects are surely not observed for all firms in all countries adopting IFRS. They find that mandatory adopters experience the most positive effects upon adoption in those countries where local accounting standards are most different from IFRS, but where legal enforcement is strong. Yu (2010) demonstrates that international mutual funds increase their investments in firms reporting under IFRS, thereby helping to further integrate markets. Yet, the expected effect for U.S. firms may be more minor, as U.S. GAAP is arguably an as good or better accounting standard than IFRS. At the same time, the transition costs of adopting a new accounting system are likely steep, especially for large firms. The SEC estimated these costs for the largest firms to be $32 million for the first 3 years of adoption. The firms likely to benefit the most from worldwide IFRS adoption are, of course, multinational firms, which may look forward to using one single standard for financial reporting across all their markets.

16.8 SUMMARY

This chapter examines advanced international capital budgeting. The main points in the chapter are as follows:

1. The weighted average cost of capital, r_{WACC}, is defined as the weighted sum of the after-tax required rate of return on the firm's debt and the required rate of return on the firm's equity, where the weights represent the percentage of the firm's value financed with debt versus equity. Discounting all-equity free cash flows at r_{WACC} provides a correct valuation only when the riskiness of the cash flows and the ability of the project to support debt are the same as those of the overall corporation.

2. The flow-to-equity (FTE) approach discounts the after-tax free cash flows to stockholders at the

required rate of return on the equity to derive the equity value of a project.

3. The adjusted net present value (ANPV) method works well when a firm knows the level of its debt in future periods. If the ratio of debt to value is more likely to be constant, the weighted average cost of capital (WACC) approach or FTE approach may be easier to use.

4. The domestic currency value of a foreign project can be found either by discounting the expected foreign currency cash flows with an appropriate foreign currency discount rate and then converting them into domestic currency using the current spot exchange rate, or by forecasting future exchange rates, multiplying them by the expected value of the future foreign currency cash flows, and then discounting them using a domestic currency discount rate.

5. The Consolidated Machine Tool Company (CMTC) case demonstrates the importance of using different discount rates for different future horizons. Furthermore, expected rates of real appreciation between currencies can substantively affect international valuations.

6. The terminal value of a project can be calculated by assuming that the rate of return on an investment will fall, because of competition, to the weighted average cost of capital.

7. When determining the tax shields associated with borrowing foreign currency, you must take account of taxes on expected capital gains or tax shields on expected losses due to the expected appreciation or depreciation of the domestic currency relative to the foreign currency.

8. The presence of debt can give rise to conflicts between a firm's stockholders and bondholders. The firm's managers can engage in asset substitution or underinvestment. Asset substitution occurs when the managers invest in projects that are more risky than bondholders expected. Underinvestment occurs when managers refuse to take on low-risk projects that would increase the firm's value because too much of the value from the project accrues to the bondholders.

9. Differences in accounting conventions across countries must be taken into account when doing international capital budgeting.

QUESTIONS

1. Why should the required rate of return for a capital budgeting problem be project specific? Doesn't the firm just have to satisfy an overall cost-of-capital requirement?

2. What is the conceptual foundation of the flow-to-equity approach to capital budgeting?

3. What is the weighted average cost of capital?

4. Should a firm ever accept a project that has a negative NPV when discounted at the weighted average cost of capital?

5. Can you do capital budgeting for a foreign project using a domestic currency discount rate? Explain your answer.

6. Why might it be important to use period-specific discount rates when doing capital budgeting?

7. Why is it necessary to consider forecasts of real currency appreciation and depreciation when doing international capital budgeting?

8. What is the rate of return on invested capital? How is it calculated?

9. If you borrow a foreign currency, what interest deduction would you receive on your taxes?

10. If you borrow a foreign currency, are there any capital gains taxes to worry about?

11. Why might a manager accept a high-variance, low-value project instead of a low-variance, high-value project?

12. Why would a manager not accept a positive net present value project?

PROBLEMS

1. Suppose that the required rate of return on a firm's debt is 8%, the corporate tax rate is 34%, and the required rate of return on the firm's equity is 15%. If the firm finances its projects with 40% debt, what is the firm's WACC?

2. Suppose that U.K. Motors Ltd. is considering an investment of £30 million to develop a new factory.

Assume that its stockholders require a 22% rate of return, that its bondholders require a 9% rate of return, that the U.K. corporate tax rate is 40%, that 35% of the project will be financed by debt, and that 65% of the project will be financed with equity. What must be the annual income from the project if it is to be a zero net present value investment?

3. If the risk-free rate is 5%, the firm's required rate of return on its debt is 6%, the equity beta is 1.4, the equity risk premium is 5.5%, the corporate tax rate is 34%, and the debt…equity ratio is 0.5, what is the expected rate of return on the assets of the firm that is predicted by the capital asset pricing model (CAPM)?

4. Suppose that a firm's corporate headquarters thinks that the appropriate dollar rate of return on investments in Japan is 18% per annum. If the dollar is expected to weaken relative to the yen by 4% per annum, what is the Japanese yen required rate of return on the expected yen cash flows?

5. Which is a better deal: borrowing at 1% in yen when the risk-free yen interest rate is 3% and the firm's market-debt rate is 4%, or borrowing in euros at 3% when the risk-free euro interest rate is 5% and the firm's market-debt rate is 6%? Assume that uncovered interest rate parity holds and that the corporate tax rate is 34%.

6. Consider a firm that owes $700 to its bondholders facing the following two mutually exclusive projects:

	PROJECT A	
	Probability	Value of Firm
Dollar Appreciation	0.5	$700
Dollar Depreciation	0.5	$800

	PROJECT B	
	Probability	Value of Firm
Dollar Appreciation	0.5	$650
Dollar Depreciation	0.5	$830

If the managers are operating in the interest of the stockholders, which project will the firm take? Why?

7. Suppose that a firm has $700 of bonds outstanding, and its cash flows without a new project will be as follows:

	FIRM WITHOUT A NEW PROJECT	
	Probability	Value of Firm
Dollar Appreciation	0.5	$600
Dollar Depreciation	0.5	$800

Suppose that the cash flows of the firm with a new project that costs $60 would be as follows:

	FIRM WITH A NEW PROJECT	
	Probability	Value of Firm
Dollar Appreciation	0.5	$700
Dollar Depreciation	0.5	$840

If the managers are acting in the interests of the shareholders, will they accept this project? Why or why not?

8. Web Question: Go to www.vodafone.com and determine the outstanding amounts of debt and equity. If the required rate of return on its debt is 75 basis points over the 10-year U.K. Treasury yield, its equity beta is 0.75, and the equity premium is 5.5%, what is Vodafone's weighted average cost of capital? *Hint:* Don't forget to find the U.K. tax rate.

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