CHAPTER OUTLINE

CHAPTER 18 International Capital Budgeting

IN THIS BOOK, we have taken the view that the fundamental goal of the financial manager is shareholder wealth maximization. Shareholder wealth is created when the firm makes an investment that will return more in a present value sense than the investment costs. Perhaps the most important decisions that confront the financial manager are which capital projects to select. By their very nature, capital projects denote investment in capital assets that make up the productive capacity of the firm. These investments, which are typically expensive relative to the firm's overall value, will determine how efficiently the firm will produce the product it intends to sell, and thus will also determine how profitable the firm will be. In total, these decisions determine the competitive position of the firm in the product marketplace and the firm's long-run survival. Consequently, a valid framework for analysis is important. The generally accepted methodology in modern finance is to use the net present value (NPV) discounted cash flow model.

In Chapter 16, we explored why a MNC would make foreign direct investment in another country. In Chapter 17, we discussed the cost of capital for a multinational firm. We saw that a firm that could source funds internationally rather than just domestically could feasibly have a lower cost of capital than a domestic firm because of its greater opportunities to raise funds. A lower cost of capital means that more capital projects will have a positive net present value to the multinational firm. Our objective in this chapter is to detail a methodology for a multinational firm to analyze the investment in a capital project in a foreign land. The methodology we present is based on an analytical framework formalized by Donald Lessard (1985). The adjusted present value (APV) methodology is an extension of the NPV technique suggested for use in analyzing domestic capital expenditures. As will be seen, the APV methodology facilitates the analysis of special cash flows that are unique to international capital expenditures.

Most readers will already be familiar with NPV analysis and its superiority in comparison to other capital expenditure evaluation techniques as a tool for assisting the financial manager in maximizing shareholder wealth. Therefore, the chapter begins with only a brief review of the basic NPV capital budgeting framework. Next, the basic NPV framework is extended into an APV model by way of analogy to the Modigliani-Miller equation for the value of a levered firm. Following this, the APV model is extended to make it suitable for use by a MNC analyzing a foreign capital investment. The chapter includes a case application showing how to implement the APV decision framework.

Review of Domestic Capital Budgeting

The basic **net present value (NPV)** capital budgeting equation can be stated as:

$$NPV = \sum_{t=1}^{T} \frac{CF_t}{(1+K)^t} + \frac{TV_T}{(1+K)^T} - C_0 \tag{18.1}$$

where:

CF_t = expected after-tax cash flow for year t,
TV_T = expected after-tax terminal value, including recapture of working capital,
C_0 = initial investment at inception,
K = weighted-average cost of capital,
T = economic life of the capital project in years.

The NPV of a capital project is the present value of all cash inflows, including those at the end of the project's life, minus the present value of all cash outflows. The *NPV rule* is to accept a project if NPV ≥ 0 and to reject it if NPV < 0.

The internal rate of return (IRR), the payback method, and the profitability index are three additional methods for analyzing a capital expenditure. The IRR method solves for the discount rate, that is, the project's IRR, that causes the NPV to equal zero. In many situations a project will have only a single IRR, and the IRR decision rule is to select the project if the IRR $\geq K$. However, under certain circumstances a project will have multiple IRRs, thus causing difficulty in interpreting the simple decision rule if one or more IRRs are less than K. The payback method determines the period of time required for the cumulative cash inflows to "pay back" the initial cash outlay; the shorter the payback period the more acceptable is the project. However, the payback method ignores the time value of money and any cash flows after the payback period. The profitability index is computed by dividing the present value of cash inflows by the initial outlay; the larger the ratio, the more acceptable is the project. However, when dealing with mutually exclusive projects, a conflict may arise between the profitability index and the NPV criterion due to the scale of the investments. If the firm is not under a capital rationing constraint, it is generally agreed that conflicts should be settled in favor of the NPV criterion. Overall, the NPV decision rule is considered the superior framework for analyzing a capital budgeting expenditure.

For our purposes, it is necessary to expand the NPV equation. First, however, it is beneficial if we discuss annual cash flows. In capital budgeting, our concern is only with the change in the firm's total cash flows that are attributable to the capital expenditure. CF_t represents the *incremental* change in total firm cash flow for year t resulting from the capital project.[1] Algebraically CF_t can be defined as:

$$CF_t = (R_t - OC_t - D_t - I_t)(1 - \tau) + D_t + I_t(1 - \tau) \tag{18.2a}$$

$$= NI_t + D_t + I_t(1 - \tau) \tag{18.2b}$$

Equation 18.2a presents a very detailed expression for **incremental cash flow** that is worth learning so that we can easily apply the model. The equation shows that CF_t is the sum of three flows, or that the cash flow from a capital project goes to three different groups. The first term, as Equation 18.2b shows, is expected income, NI_t, which belongs to the equity holders of the firm. Incremental NI_t is calculated as the after-tax $(1 - \tau)$ value of the change in the firm's sales revenue, R_t, generated from the project, minus the corresponding operating costs, OC_t, minus project depreciation, D_t, minus interest expense, I_t. (As we discuss later in the chapter, we are only concerned with the interest expense that is consistent with the firm's optimal capital structure and the borrowing capacity created by the project.) The second term represents the fact that

[1]For simplicity, we assume that no additional capital expenditure or investment in working capital is required after inception.

depreciation is a *noncash* expense, that is, D_t is subtracted in the calculation of NI_t only for tax purposes. It is added back because this cash did not actually flow out of the firm in year t. D_t can be viewed as the recapture in year t of a portion of the original investment, C_0, in the project. The last term represents the firm's after-tax payment of interest to debtholders.

$$CF_t = (R_t - OC_t - D_t)(1 - \tau) + D_t \quad \textbf{(18.2c)}$$

$$= NOI_t(1 - \tau) + D_t \quad \textbf{(18.2d)}$$

Equation 18.2c provides a computationally simpler formula for calculating CF_t. Since $I_t(1 - \tau)$ is subtracted in determining NI_t in Equation 18.2a and then added back, the two cancel out. The first term in Equation 18.2c represents after-tax net operating income, $NOI_t(1 - \tau)$, as stated in Equation 18.2d.

$$CF_t = (R_t - OC_t)(1 - \tau) + \tau D_t \quad \textbf{(18.2e)}$$

$$= OCF_t(1 - \tau) + \tau D_t \quad \textbf{(18.2f)}$$

$$= \text{nominal after-tax incremental cash flow for year } t$$

Equation 18.2e provides yet an even simpler formula for calculating CF_t. It shows the result from Equation 18.2c of combining the after-tax value of the depreciation expense, $(1 - \tau)D_t$, with the before-tax value of D_t. The result of this combination is the amount τD_t in Equation 18.2e, which represents the tax saving due to D_t being a tax-deductible item. As summarized in Equation 18.2f, the first term in Equation 18.2e represents after-tax operating cash flow, $OCF_t(1 - \tau)$, and the second term denotes the tax savings from the depreciation expense.[2]

The Adjusted Present Value Model

To continue on with our discussion, we need to expand the NPV model. To do this, we substitute Equation 18.2f for CF_t in Equation 18.1, allowing us to restate the NPV formula as:

$$\text{NPV} = \sum_{t=1}^{T} \frac{OCF_t(1 - \tau)}{(1 + K)^t} + \sum_{t=1}^{T} \frac{\tau D_t}{(1 + K)^t} + \frac{TV_t}{(1 + K)^T} - C_0 \quad \textbf{(18.3)}$$

In a famous article, Franco Modigliani and Merton Miller (1963) derived a theoretical statement for the market value of a levered firm (V_l) versus the market value of an equivalent unlevered firm (V_u). They showed that

$$V_l = V_u + \tau\text{Debt} \quad \textbf{(18.4a)}$$

Assuming the firms are ongoing concerns and the debt the levered firm issued to finance a portion of its productive capacity is perpetual, Equation 18.4a can be expanded as:

$$\frac{NOI(1 - \tau)}{K} = \frac{NOI(1 - \tau)}{K_u} + \frac{\tau I}{i} \quad \textbf{(18.4b)}$$

where i is the levered firm's borrowing rate, $I = i\text{Debt}$, and K_u is the **all-equity cost of equity** (i.e., the cost of equity for a firm financed only with equity).

Recall from Chapter 17 that the weighted average cost of capital can be stated as:

$$K = (1 - \lambda)K_l + \lambda i(1 - \tau) \quad \textbf{(18.5a)}$$

[2]Annual cash flows might also include incremental working capital funds. These are ignored here to simplify the presentation.

EXHIBIT 18.1

Comparison of Cash Flows Available to Investors

	Levered	Unlevered
Revenue	$100	$100
Operating costs	−50	−50
Net operating income	50	50
Interest expense	−10	−0
Earnings before taxes	40	50
Taxes @.40	−16	−20
Net income	24	30
Cash flow available to investors	$24 + 10 = $34	$ 30

where K_l is the cost of equity for a levered firm, and λ is the optimal debt ratio. In their article, Modigliani and Miller showed that K can be stated as:[3]

$$K = K_u(1 - \tau\lambda) \tag{18.5b}$$

Recall that Equation 18.2a can be simplified to Equation 18.2d. What this implies is that regardless of how the firm (or a capital expenditure) is financed, it will earn the same NOI. From Equation 18.5b, if $\lambda = 0$ (that is, an all-equity financed firm), then $K = K_u$ and $I = 0$; thus in Equation 18.4a $V_l = V_u$. However, if $\lambda > 0$ (that is, a levered firm), then $K_u > K$ and $I > 0$, thus $V_l > V_u$. For Equation 18.4b to hold as an equality, it is necessary to add the present value of the tax savings the levered firm receives. The main result of Modigliani and Miller's theory is that the value of a levered firm is greater than an equivalent unlevered firm earning the same NOI because the levered firm also has tax savings from the tax deductibility of interest payments to debtholders that do not go to the government. The following example clarifies the tax savings to the firm from making interest payments on debt.

EXAMPLE | 18.1: Tax Savings from Interest Payments

Exhibit 18.1 provides an example of the tax savings arising from the tax deductibility of interest payments. The exhibit shows a levered and an unlevered firm, each with sales revenue and operating expenses of $100 and $50, respectively. The levered firm has interest expense of $10 and earnings before taxes of $40, while the unlevered firm enjoys $50 of before-tax earnings since it does not have any interest expense. The levered firm pays only $16 in taxes as opposed to $20 for the unlevered firm. This leaves $24 for the levered firm's shareholders and $30 for the unlevered firm's shareholders. Nevertheless, the levered firm has a total of $34 (=$24 + $10) of funds available for investors, while the unlevered firm has only $30. The extra $4 comes from the tax savings on the $10 before-tax interest payment.

By direct analogy to the Modigliani-Miller equation for an unlevered firm, we can convert the NPV Equation 18.3 into the **adjusted present value (APV)** model:

$$APV = \sum_{\tau\ 1}^{T} \frac{OCF_t(1-\tau)}{(1+K_u)^t} + \sum_{t=1}^{T} \frac{\tau D_t}{(1+i)^t} + \sum_{t=1}^{T} \frac{\tau I_t}{(1+i)^t} + \frac{TV_T}{(1+K_u)^T} - C_0 \tag{18.6}$$

[3]To derive Equation 18.5b from Equation 18.5a, it is necessary to know that $K_l = K_u + (1 - \tau)(K_u - i)$ (Debt/Equity).

The APV model is a **value-additivity** approach to capital budgeting. That is, each cash flow that is a source of value is considered individually. Note that in the APV model, each cash flow is discounted at a rate of discount consistent with the risk inherent in that cash flow. The OCF_t and TV_T are discounted at K_u. The firm would receive these cash flows from a capital project regardless of whether the firm was levered or unlevered. The tax savings due to interest, τI_t, are discounted at the before-tax borrowing rate, i, as in Equation 18.4b. It is suggested that the tax savings due to depreciation, τD_t, also be discounted at i because these cash flows are relatively less risky than operating cash flows if tax laws are not likely to change radically over the economic life of the project.[4]

The APV model is useful for a domestic firm analyzing a domestic capital expenditure. If APV ≥ 0, the project should be accepted. If APV < 0, the project should be rejected. Thus, the model is useful for a MNC for analyzing one of its domestic capital expenditures or for a foreign subsidiary of the MNC analyzing a proposed capital expenditure from the subsidiary's viewpoint.

Capital Budgeting from the Parent Firm's Perspective

The APV model as stated in Equation 18.6 is not useful for the MNC in analyzing a foreign capital expenditure of one of its subsidiaries from the MNC's, or parent's, perspective. In fact, it is possible that a project may have a positive APV from the subsidiary's perspective and a negative APV from the parent's perspective. This could happen, for example, if certain cash flows are blocked by the host country from being legally remitted to the parent or if extra taxes are imposed by the host country on foreign exchange remittances. A higher marginal tax rate in the home country may also cause a project to be unprofitable from the parent's perspective. If we assume the MNC owns the foreign subsidiary, but domestic shareholders own the MNC parent, it is the currency of the parent firm that is important because it is that currency into which the cash flows must be converted to benefit the shareholders whose wealth the MNC is attempting to maximize.[5]

Donald Lessard (1985) developed an APV model that is suitable for a MNC to use in analyzing a foreign capital expenditure. The model recognizes that the cash flows will be denominated in a foreign currency and will have to be converted into the currency of the parent. Additionally, Lessard's model incorporates special cash flows that are frequently encountered in foreign project analysis. Using the basic structure of the APV model developed in the previous section, Lessard's model can be stated as:

$$\text{APV} = \sum_{t=1}^{T} \frac{\bar{S}_t OCF_t(1-\tau)}{(1+K_{ud})^t} + \sum_{t=1}^{T} \frac{\bar{S}_t \tau D_t}{(1+i_d)^t} + \sum_{t=1}^{T} \frac{\bar{S}_t \tau I_t}{(1+i_d)^t} + \frac{\bar{S}_T TV_t}{(1+K_{ud})^T}$$
$$- S_0C_0 + S_0RF_0 + S_0CL_0 - \sum_{t=1}^{T} \frac{\bar{S}_t LP_t}{(1+i_d)^t} \qquad (18.7)$$

Several points are noteworthy about Equation 18.7. First, the cash flows are assumed to be denominated in the foreign currency and converted to the currency of the parent at the expected spot exchange rates, $\bar{S}_t$, applicable for year t. The marginal

[4]Booth (1982) shows under what circumstances the NPV and APV methods will be precisely equivalent.

[5]When both $NPV_{parent} > 0$ and $NPV_{subsidiary} > 0$, the decision to make the capital expenditure is clear. Similarly, the decision to not invest is clear when $NPV_{parent} < 0$ and $NPV_{subsidiary} < 0$, as it is when $NPV_{parent} < 0$ and $NPV_{subsidiary} > 0$. However, when $NPV_{parent} > 0$ and $NPV_{subsidiary} < 0$, the firm should carefully review the assumptions used in calculating the two NPVs to be certain there is consistency between the analyses before making the investment.

corporate tax rate, τ, is the larger of the parent's or the foreign subsidiary's because the model assumes that the tax authority in the parent firm's home country will give a foreign tax credit for foreign taxes paid *up to* the amount of the tax liability in the home country. Thus, if the parent's tax rate is the larger of the two, additional taxes are due in the home country, which equals the difference between the domestic tax liability and the foreign tax credit. On the other hand, if the foreign tax rate is larger, the foreign tax credit more than offsets the domestic tax liability, so no additional taxes are due.[6] It is also noted that each of the discount rates has the subscript d, indicating that once the foreign cash flows are converted into the parent's home currency, the appropriate discount rates are those of the domestic country.

In Equation 18.7, the OCF_t represents only the portion of operating cash flows available for remittance that can be legally remitted to the parent firm. Cash flows earned in the foreign country that are blocked by the host government from being repatriated do not provide any benefit to the stockholders of the parent firm and are not relevant to the analysis. Additionally, cash flows that are repatriated through circumventing restrictions are not included here.

As with domestic project analysis, it is important to include only incremental revenues and operating costs in calculating the OCF_t. An example will help illustrate the concept. A MNC may currently have a sales affiliate in a foreign country who is supplied by merchandise produced by the parent or a manufacturing facility in a third country. If a manufacturing facility is put into operation in the foreign country to satisfy local demand, sales may be higher overall than with just a sales affiliate if the foreign subsidiary is better able to assess market demand with its local presence. However, the former manufacturing unit will experience **lost sales** as a result of the new foreign manufacturing facility; that is, the new project has *cannibalized* part of an existing project. Thus, incremental revenue is not the total sales revenue of the new manufacturing facility but rather that amount minus the lost sales revenue. However, if the sales would be lost regardless, say because a competitor who is better able to satisfy local demand is gearing up, then the entire sales revenue of the new foreign manufacturing facility is incremental sales revenue.

Equation 18.7 includes additional terms representing cash flows frequently encountered in foreign projects. The term S_0RF_0 represents the value of accumulated **restricted funds** (of amount RF_0) in the foreign land from existing operations that are freed up by the proposed project. These funds become available only *because* of the proposed project and are therefore available to offset a portion of the initial capital outlay. Examples are funds "whose use is restricted by exchange controls"[7] or funds on which additional taxes would be due in the parent country if they were remitted. RF_0 equals the difference between the face value of these funds and their present value used in the next best alternative. The extended illustration at the end of this chapter will help clarify the meaning of this term.

The term $S_0CL_0 - \sum_{t=1}^{T} \frac{\bar{S}_t LP_t}{(1 + i_d)^t}$ denotes the present value in the currency of the parent firm of the benefit of below-market-rate borrowing in foreign currency. In certain cases, a **concessionary loan** (of amount CL_0) at a below-market rate of interest may be available to the parent firm if the proposed capital expenditure is made in the foreign land. The host country offers this financing in its foreign currency as a means of attracting economic development and investment that will create employment for

www.worldbank.org

This website of the World Bank provides information on doing business in the developing world, including information on financing instruments.

[6]This implicitly assumes that all net operating cash flows are remitted immediately to the parent firm and that the parent has no excess foreign tax credits. Chapter 21 covers the complicated topic of international taxation, withholding taxes, and foreign tax credits that may complicate Lessard's APV model and that can be incorporated in additional terms to the basic model. Additionally, Chapter 21 discusses transfer pricing strategies that may allow the firm to move taxable income from high to low tax regimes.

[7]Lessard (1985, p. 577).

its citizens. The benefit to the MNC is the difference between the face value of the concessionary loan converted into the home currency and the present value of the similarly converted concessionary loan payments (LP_t) discounted at the MNC's normal domestic borrowing rate (i_d). The loan payments will yield a present value less than the face amount of the concessionary loan when they are discounted at the higher normal rate. This difference represents a subsidy the host country is willing to extend to the MNC if the investment is made. It should be clear that the present value of the loan payments discounted at the normal borrowing rate represents the size of the loan available from borrowing at the normal borrowing rate with a debt service schedule equivalent to that of the concessionary loan.

Recall that to calculate the firm's weighted-average cost of capital, it is necessary to know the firm's optimal debt ratio. When considering a capital budgeting project, it is never appropriate to think of the project as being financed separately from the way the firm is financed, for the project represents a portion of the firm. When the asset base increases because a capital project is undertaken, the firm can handle more debt in its capital structure. That is, the borrowing capacity of the firm has increased because of the project. Nevertheless, the investment and financing decisions are separate. There is an optimal capital structure for the firm; once this is determined, the cost of financing is known and can be used to determine if a project is acceptable. We do not mean to imply that *each* and every capital project is financed with the optimal portions of debt and equity. Rather, some projects may be financed with all debt or all equity or a suboptimal combination. What is important is that in the long run the firm does not stray too far from its optimal capital structure so that overall the firm's assets are financed at the lowest cost. Thus, the interest tax shield term $S_t \tau I_t$ in the APV model recognizes the tax shields of the **borrowing capacity** created by the project *regardless* of how the project is financed. Handling the tax shields in any other way would bias the APV favorably or unfavorably, respectively, if the project was financed by a larger or smaller portion of debt. This is an especially important point in international capital budgeting analysis because of the frequency of large concessionary loans. The benefit of concessionary loans, which are dependent on the parent firm making the investment, is recognized in a separate term.[8]

Generality of the APV Model

Lessard's APV model includes many terms for cash flows frequently encountered in analyzing foreign capital expenditures. However, *all* possible terms are not included in the version presented as Equation 18.7. Nevertheless, the reader should now have the knowledge to incorporate into the basic APV model terms of a more unique nature for specific cash flows encountered in a particular analysis.

For example, there may be tax savings or deferrals that come about because of multinational operations. That is, the MNC may be able to shift revenues or expenses among its affiliates in a way that lowers taxes, or be able to combine profits or affiliates from both low- and high-tax environments in a manner that results in lower overall taxes. Tax deferrals are possible by reinvesting profits in new capital projects in low-tax countries.

Additionally, through interaffiliate transfer pricing strategies, licensing arrangements, royalty agreements, or other means, the parent firm might be able to repatriate some funds that are meant to be blocked, or restricted, by the host country.[9] These cash flows are the counterpart to the unrestricted funds available for remittance as part of operating cash flows. As with the cash flows arising from tax savings or deferrals, it may be difficult for the firm to accurately estimate the size of these cash flows or their duration. Since these cash flows will exist regardless of how the firm is financed, they should be discounted at the all-equity rate.

---

[8]Booth (1982) shows that tax shields calculated using the concessionary loan rates are also theoretically correct.

[9]Chapter 19 covers interaffiliate transfer pricing strategies, licensing arrangements, and royalty agreements as methods the parent firm might use to repatriate funds restricted by the host country.

One of the major benefits of the APV framework is the ease with which difficult cash flow terms, such as tax savings or deferrals and the repatriation of restricted funds, can be handled. The analyst can first analyze the capital expenditure as if these terms did not exist. Additional cash flow terms do not need to be explicitly considered unless the APV is negative. If the APV is negative, the analyst can calculate how large the cash flows from other sources need to be to make the APV positive, and then estimate whether these other cash inflows will likely be that large.

Estimating the Future Expected Exchange Rate

The financial manager must estimate the future expected exchange rates, $\bar{S}_t$, in order to implement the APV framework. Chapter 6 provided a wide variety of methods for estimating exchange rates. One quick and simple way to do this is to rely on PPP and estimate the future expected spot rate for year t as:

$$\bar{S}_t = S_0 (1 + \bar{\pi}_d)^t/(1 + \bar{\pi}_f)^t \quad \textbf{(18.8)}$$

where $\bar{\pi}_d$ is the expected long-run annual rate of inflation in the (home) domestic country of the MNC and $\bar{\pi}_f$ is the rate in the foreign land.

As noted in Chapter 6, PPP is not likely to hold precisely in reality. Nevertheless, unless the financial manager suspects that there is some systematic long-run bias in using PPP to estimate $\bar{S}_t$ that would result in a systematic over- or underestimate of the series of expected exchange rates, then PPP should prove to be an acceptable tool. Alternatively, the analyst may choose to use long-dated forward prices to estimate the future expected spot exchange rates, or use an IRP forecast.

CASE APPLICATION

The Centralia Corporation

The Centralia Corporation is a midwestern manufacturer of small kitchen electrical appliances. The market segment it caters to is the midprice range. It specializes in small and medium-size microwave ovens suitable for small homes, apartment dwellers, or office coffee lounges. In recent years it has been exporting microwave ovens to Spain, where they are sold through a sales affiliate in Madrid. Because of different electrical standards in various European countries, the ovens Centralia manufactured for the Spanish market could not be used everywhere in Europe without an electrical converter. Thus, the sales affiliate concentrated its marketing effort just in Spain. Sales are currently 9,600 units a year and have been increasing at a rate of 5 percent.

Centralia's marketing manager has been keeping abreast of integration activities in the European Union. All obstacles to the free movement of goods, services, people, and capital among the member states of the EU have been removed. Additionally, further integration promises a commonality among member states of rail track size, telephone and electrical equipment, and a host of other items. These developments have led the marketing manager to believe that a substantial number of microwave oven units could be sold throughout the EU and that the idea of a manufacturing facility should be explored.

The marketing and production managers have jointly drawn up plans for a wholly owned manufacturing facility in Zaragoza, which is located about 325 kilometers northeast of Madrid. Zaragoza is located just a couple hundred kilometers from the French border, thus facilitating shipment out of Spain into other EU countries. Additionally, Zaragoza is located close enough to the major population centers in Spain so that internal shipments should not pose a problem. A major attraction of locating the manufacturing facility in Zaragoza, however, is that the Spanish government has promised to arrange for a large portion of the construction cost of the production facility to be financed at a very attractive interest rate if the plant is built there. Any type of industry that will improve the employment situation would be a benefit, as the current unemployment rate in Spain exceeds 19 percent. Centralia's executive committee has instructed the financial manager to determine if the plan has financial merit. If the manufacturing facility is built, Centralia will no longer export units for sale in Europe. The necessary information follows.

On its current exports, Centralia receives \$180 per unit, of which \$35 represents contribution margin. The sales forecast predicts that 25,000 units will be sold within the EU during the first year of operation and that this volume will increase at the rate of 12 percent per year. All sales will be invoiced in euros. When the plant begins operation, units will be priced at €200 each. It is estimated that the current production cost will be €160 per unit. The sales price and production costs are expected to keep pace with inflation, which is forecast to be 2.1 percent per annum for the foreseeable future. By comparison, long-run U.S. inflation is forecast at 3 percent per annum. The current exchange rate is \$1.32/€1.00.

The cost of constructing the manufacturing plant is estimated at €5,500,000. The borrowing capacity created by a capital expenditure of this amount is \$2,904,000. The Madrid sales affiliate has accumulated a net amount of €750,000 from its operations, which can be used to partially finance the construction cost. The marginal corporate tax rate in Spain and the United States is 35 percent. The accumulated funds were earned under special tax concessions offered during the initial years of the sales operation, and taxed at a marginal rate of 20 percent. If they were repatriated, additional tax at the 35 percent marginal rate would be due, but with a foreign tax credit given for the Spanish taxes already paid.

The Spanish government will allow the plant to be depreciated over an eight-year period. Little, if any, additional investment will be required over that time. At the end of this period, the market value of the facility is difficult to estimate, but Centralia believes that the plant should still be in good condition for its age and that it should therefore have reasonable market value. All after-tax operating cash flows from the new facility will be immediately repatriated to the United States.

One of the most attractive features of the proposal is the special financing the Spanish government is willing to arrange. If the plant is built in Zaragoza, Centralia will be eligible to borrow €4,000,000 at a concessionary loan rate of 5 percent per annum. The normal borrowing rate for Centralia is 8 percent in dollars and 7 percent in euros. The loan schedule calls for the principal to be repaid in eight equal installments. In dollar terms, Centralia uses 12 percent as its **all-equity cost of capital**.

Here is a summary of the key points:

The current exchange rate in American terms is $S_0 = \$1.32/€1.00$.

$\overline{\pi}_f = 2.1\%$.

$\overline{\pi}_d = 3\%$.

The initial cost of the project in U.S. dollars is

$S_0C_0 = \$1.32 \times €5{,}500{,}000 = \$7{,}260{,}000$.

For simplicity, we will assume that PPP holds and use it to estimate future expected spot exchange rates in American terms as:

$\overline{S}_t = 1.32(1.03)^t/(1.021)^t$.

The before-tax incremental operating cash flow per unit at $t = 1$ is €200 − 160 = €40. The nominal contribution margin in year t equals €40$(1.021)^{t-1}$.

Incremental lost sales in units for year t equals $9{,}600(1.05)^t$.

Contribution margin per unit of lost sales in year t equals \$35$(1.03)^t$.

The marginal tax rate, τ equals the Spanish (or U.S.) rate of 35 percent.

Terminal value will initially be assumed to equal zero.

Straight-line depreciation is assumed; D_t = €687,500 = €5,500,000/8 years.

$K_{ud} = 12\%$.

$i_c = 5\%$.

$i_d = 8\%$.

In Exhibit 18.2 the present value of the expected after-tax operating cash flows from Centralia establishing the manufacturing facility in Spain is calculated. Column (a)

EXHIBIT 18.2 Calculation of the Present Value of the After-Tax Operating Cash Flows

Year (t)	$\bar{S}_t$	Quantity	$\bar{S}_t \times$ Quantity $\times$ €40 $\times (1.021^{t-1})$ (a) $	Quantity Lost Sales	Quantity Lost Sales $\times$ \$35.00 $\times (1.03)^t$ (b) $	$\bar{S}_t OCF_t$ (a + b) $	$\frac{\bar{S}_t OCF_t(1-\tau)}{(1+K_{ud})^t}$ $
1	1.3316	25,000	1,331,636	(10,080)	(363,384)	968,252	561,932
2	1.3434	28,000	1,536,175	(10,584)	(393,000)	1,143,175	592,366
3	1.3552	31,360	1,772,131	(11,113)	(425,029)	1,347,102	623,246
4	1.3672	35,123	2,044,331	(11,669)	(459,669)	1,584,662	654,603
5	1.3792	39,338	2,358,340	(12,252)	(497,132)	1,861,208	686,465
6	1.3914	44,059	2,720,581	(12,865)	(537,648)	2,182,932	718,862
7	1.4036	49,346	3,138,462	(13,508)	(581,467)	2,556,995	751,826
8	1.4160	55,267	3,620,530	(14,184)	(628,856)	2,991,674	785,386
							5,374,685

presents the annual revenue in dollars from operating the new manufacturing facility. These are calculated each year by multiplying the expected quantity of microwave ovens to be sold times the year one incremental operating cash flow of €40 per unit. This product is in turn multiplied by the euro zone price inflation factor of 2.1 percent. For example, for year $t = 2$ the factor is $(1.021)^{t-1} = (1.021)$. The euro sales estimates are then converted to dollars at the expected spot exchange rates. Column (b) presents the annual lost sales revenues in dollars that are expected to result if the manufacturing facility is built and the parent firm no longer sells part of its production through the Spanish sales affiliate. These are calculated by multiplying the estimated quantity of lost sales in units by the current contribution margin of \$35 per unit, which is in turn multiplied by a 3 percent U.S. price inflation factor. The incremental dollar operating cash flows are the sum of columns (a) and (b), which are converted to their after-tax value and discounted at K_{ud}. The sum of their present values is \$5,374,685.

The present value of the depreciation tax shields τD_t is calculated in Exhibit 18.3. The tax savings on the annual straight-line depreciation of €687,500 is converted to dollars at the expected future spot exchange rates and discounted to the present at the domestic borrowing rate of 8 percent. The present value of these tax shields is \$1,892,502.

The present value of the benefit of the concessionary loan is calculated in Exhibits 18.4 and 18.5. Exhibit 18.4 finds the present value of the concessionary loan payments in dollars. Since the annual principal payment on the €4,000,000 concessionary loan is the same each year, the interest payments decline as the loan

EXHIBIT 18.3 Calculation of the Present Value of the Depreciation Tax Shields

Year (t)	$\bar{S}_t$	D_t €	$\frac{\bar{S}_t \tau D_t}{(1+i_d)^t}$ $
1	1.3316	687,500	296,690
2	1.3434	687,500	277,134
3	1.3552	687,500	258,868
4	1.3672	687,500	241,805
5	1.3792	687,500	225,867
6	1.3914	687,500	210,980
7	1.4036	687,500	197,074
8	1.4160	687,500	184,084
			1,892,502

EXHIBIT 18.4

Calculation of the Present Value of the Concessionary Loan Payments

Year (t)	$\bar{S}_t$ (a)	Principal Payment (b) €	I_t (c) €	$\bar{S}_t LP_t$ (a) × (b + c) $	$\frac{\bar{S}_t LP_t}{(1+i_d)^t}$ $
1	1.3316	500,000	200,000	932,145	863,097
2	1.3434	500,000	175,000	906,777	777,415
3	1.3552	500,000	150,000	880,890	699,279
4	1.3672	500,000	125,000	854,476	628,065
5	1.3792	500,000	100,000	827,528	563,202
6	1.3914	500,000	75,000	800,038	504,160
7	1.4036	500,000	50,000	771,999	450,454
8	1.4160	500,000	25,000	743,404	401,638
		4,000,000			4,887,311

EXHIBIT 18.5

Calculation of the Present Value of the Benefit from the Concessionary Loan

$$S_0 CL_0 - \sum_{t=1}^{T} \frac{\bar{S}_t LP_t}{(1+i_d)^t} = \$1.32 \times €4{,}000{,}000 - \$4{,}887{,}311 = \$392{,}689$$

balance declines. For example, during the first year, interest of €200,000 (= .05 × €4,000,000) is paid on the full amount borrowed. During the second year interest of €175,000 (= .05 × (€4,000,000 − 500,000)) is paid on the outstanding balance over year two. The annual loan payment equals the sum of the annual principal payment and the annual interest charge. The sum of their present values in dollars, converted at the expected spot exchange rates, discounted at the domestic borrowing rate of 8 percent, is $4,887,311. This sum represents the size of the equivalent loan available (in dollars) from borrowing at the normal borrowing rate with a debt service schedule equivalent to that of the concessionary loan.

Exhibit 18.5 concludes the analysis of the concessionary loan. It shows the difference between the dollar value of the concessionary loan and the equivalent dollar loan value calculated in Exhibit 18.4. The difference of $392,689 represents the present value of the benefit of the below-market-rate financing of the concessionary loan.

The present value of the interest tax shields is calculated in Exhibit 18.6. The interest payments in column (b) of Exhibit 18.6 are drawn from column (c) of Exhibit 18.4. That is, we follow a conservative approach and base the interest tax shields on using the concessionary loan interest rate of 5 percent. The concessionary loan of €4,000,000

EXHIBIT 18.6

Calculation of the Present Value of the Interest Tax Shields

Year (t)	$\bar{S}_t$ (a)	I_t (b) €	λ/Project Debt Ratio (c)	$\bar{S}_t\tau(.55)I_t$ (a × b × c × τ) $	$\frac{\bar{S}_t\tau(.55)I_t}{(1+i_d)^t}$ $
1	1.3316	200,000	0.55	51,268	47,470
2	1.3434	175,000	0.55	45,255	38,799
3	1.3552	150,000	0.55	39,132	31,064
4	1.3672	125,000	0.55	32,897	24,181
5	1.3792	100,000	0.55	26,550	18,069
6	1.3914	75,000	0.55	20,088	12,659
7	1.4036	50,000	0.55	13,510	7,883
8	1.4160	25,000	0.55	6,815	3,682
					183,807

represents 72.73 percent of the project cost of €5,500,000. By comparison, the borrowing capacity created by the project is $2,904,000, which implies an optimal debt ratio λ for the parent firm of 40.0 percent = $2,904,000/$7,260,000 of the dollar cost of the project. Thus, only 55.0 percent (= 40.0%/72.73%) of the interest payments on the concessionary loan should be used to calculate the interest tax shields. At the domestic borrowing rate of 8 percent, the present value of the interest tax shields is $183,807.

To calculate the amount of the freed-up restricted remittances it is first necessary to gross up the after-tax value of the net accumulation of €750,000, on which the Madrid sales affiliate has previously paid taxes at the rate of 20 percent. This amount is €937,500 = €750,000/(1 − .20). The dollar value of this sum at the current spot exchange rate S_0 is $1,237,500 = $1.32 (€937,500). If Centralia decided not to establish a manufacturing facility in Spain, the €750,000 should be repatriated to the parent firm. It would be required to pay additional taxes in the United States in the amount of $185,625 = (.35 − .20)$1,237,500. If the manufacturing facility is built, the €750,000 should not be remitted to the parent firm. Thus, freed-up funds of $185,625 result from the current tax savings, which can be applied to cover a portion of the equity investment in the capital expenditure.[10]

$$\begin{aligned}\text{The APV} &= \$5{,}374{,}685 + 1{,}892{,}502 + 392{,}689 + 183{,}807 + 185{,}625 \\ &\quad - 7{,}260{,}000 \\ &= \$769{,}308.\end{aligned}$$

There appears little doubt that the proposed manufacturing facility will be a profitable venture for Centralia. Had the APV been negative or closer to zero, we would want to consider the present value of the after-tax terminal cash flow. We are quite uncertain as to what this amount might be, and, fortunately, in this case we do not have to base a decision on this cash flow, which is difficult at best to forecast.

Risk Adjustment in the Capital Budgeting Analysis

The APV model we presented and demonstrated is suitable for use in analyzing a capital expenditure that is of average riskiness in comparison to the firm as a whole. Some projects may be more or less risky than average, however. The *risk-adjusted discount method* is the standard way to handle this situation. This approach requires adjusting the discount rate upward or downward for increases or decreases, respectively, in the systematic risk of the project relative to the firm as a whole. In the APV model presented in Equation 18.7, only the cash flows discounted at K_{ud} incorporate systematic risk; thus, only K_{ud} needs to be adjusted when project risk differs from that of the firm as a whole.[11]

A second way to adjust for risk in the APV framework is the *certainty equivalent method*. This approach extracts the risk premium from the expected cash flows to convert them into equivalent riskless cash flows, which are then discounted at the risk-free rate of interest. This is accomplished by multiplying the risky cash flows by a certainty-equivalent factor that is unity or less. The more risky the cash flow, the smaller is the certainty-equivalent factor. In general, cash flows tend to be more risky the further into the future they are expected to be received. We favor the risk-adjusted discount rate method over the certainty-equivalent approach because we find that it is easier to adjust the discount rate than it is to estimate the appropriate certainty-equivalent factors.[12]

[10]At the termination date, when all excess funds are repatriated to the parent firm, additional taxes will then be due on the accumulated funds. These are taken into consideration in the terminal value TV_T term.

[11]See Ross, Westerfield, and Jaffe (2008, Chapter 12) for a treatment of capital budgeting using discount rates adjusted for project systematic risk.

[12]See Brealey, Myers and Allen (2008, Chapter 10) for a more detailed discussion of the certainty equivalent method of risk adjustment.

Sensitivity Analysis

The way we have approached the analysis of Centralia's expansion into Spain is to obtain a point estimate of the APV through using expected values of the relevant cash flows. The expected values of these inputs are what the financial manager expects to obtain given the information he had at his disposal at the time the analysis was performed. However, each cash flow does have its own probability distribution. Hence, the realized value that may result for a particular cash flow may be different than expected. To examine these possibilities, the financial manager typically performs a sensitivity analysis. In a *sensitivity analysis,* different scenarios are examined by using different exchange rate estimates, inflation rate estimates, and cost and pricing estimates in the calculation of the APV. In essence, the sensitivity analysis allows the financial manager a means to analyze the business risk, economic exposure, exchange rate uncertainty, and political risk inherent in the investment. Sensitivity analysis puts financial managers in a position to more thoroughly understand the implications of planned capital expenditures. It also forces them to consider in advance actions that can be taken should an investment not develop as anticipated. Excel-based programs, such as Crystal Ball, can be easily used to conduct a Monte Carlo simulation of various probability assumptions.

Purchasing Power Parity Assumption

The APV methodology we developed assumes that PPP holds and that future expected exchange rates can be forecasted accordingly. As noted, relying on the PPP assumption is a common and conceptually satisfying way to forecast future exchange rates. Assuming no differential in marginal tax rates, when PPP holds and all foreign cash flows can be legally repatriated to the parent firm, it does not make any difference if the capital budgeting analysis is done from the perspective of the parent firm or from the perspective of the foreign subsidiary. To see this, consider the following simple example.

EXAMPLE | 18.2: The PPP Assumption in Foreign Capital Expenditure Analysis

A capital expenditure of FC30 by a foreign subsidiary of a U.S. MNC with a one-year economic life is expected to earn a cash flow in local currency terms of FC80. Assume inflation in the foreign host country is forecast at 4 percent per annum and at 2 percent in the United States. If the U.S. MNC's cost of capital is 7.88 percent, the Fisher equation determines that the appropriate cost of capital for the foreign subsidiary is 10 percent: 1.10 = (1.0788)(1.04)/(1.02). Consequently, the project NPV in foreign currency terms is $NPV_{FC} = FC80/(1.10) - FC30 = FC42.73$. If the current spot exchange rate is *FC*2.00/\$1.00, $\bar{S}_1(FC/\$) = 2.00\,(1.04)/(1.02) = 2.0392$ by PPP. In U.S. dollar terms, $NPV_\$ = (FC80/2.0392)/(1.0788) - FC30/2.00 = \$21.37$. Note that according to the *law of one price,* $NPV_{FC}/S_0\,(FC/\$) = NPV_\$ = FC42.73/2.00 =$ \$21.37. This is the expected result because both the exchange rate forecast and the discount rate conversion incorporate the same differential in expected inflation rates. Suppose, however, that $\bar{S}_1(FC/\$)$ actually turns out to be *FC*5.00/\$1.00, that is, the foreign currency depreciates in real terms versus the dollar, then $NPV_\$ = -\$0.17$ and the project is unprofitable from the parent's perspective.

Real Options

Throughout this chapter, we have recommended the APV framework for evaluating capital expenditures in real assets. The APV was determined by making certain assumptions about revenues, operating costs, exchange rates, and the like. This approach treats risk through the discount rate. When evaluated at the appropriate discount rate, a positive APV implies that a project should be accepted and a negative APV implies that it should be rejected. A project is accepted under the assumption that all future operating decisions will be optimal. Unfortunately, the firm's management does not know at the inception date of a project what future decisions it will be confronted with because complete information concerning the project has not yet been learned. Consequently, the firm's management has alternative paths, or options, that it can take as new information is discovered. Options pricing theory is useful for evaluating investment opportunities in real assets as well as financial assets, such as foreign exchange that we considered in Chapter 7. The application of options pricing theory to the evaluation of investment options in real projects is known as **real options**.

The firm is confronted with many possible real options over the life of a capital asset. For example, the firm may have a *timing option* about when to make the investment; it may have a *growth option* to increase the scale of the investment; it may have a *suspension option* to temporarily cease production; and, it may have an *abandonment option* to quit the investment early. All of these situations can be evaluated as real options.

In international capital expenditures, the MNC is faced with the political uncertainties of doing business in a foreign host country.[13] For example, a stable political environment for foreign investment may turn unfavorable if a different political party wins power by election—or worse, by political coup. Moreover, an unexpected change in a host country's monetary policy may cause a depreciation in its exchange rate versus the parent firm's home currency, thus adversely affecting the return to the shareholders of the parent firm. These and other political uncertainties make real options analysis ideal for use in evaluating international capital expenditures. Real options analysis, however, should be thought of as an extension of discounted cash flow analysis, not as a replacement of it, as the following example makes clear.

EXAMPLE | 18.3: Centralia's Timing Option

Suppose that the sales forecast for the first year for Centralia in the case application had been for only 22,000 units instead of 25,000. At the lower figure, the APV would have been −$55,358. It is doubtful that Centralia would have entered into the construction of a manufacturing facility in Spain in this event. Suppose further that it is well known that the European Central Bank has been contemplating either tightening or loosening the economy of the European Union through a change in monetary policy that would cause the euro to either appreciate to $1.45/€1.00 or depreciate to $1.20/€1.00 from its current level of $1.32/€1.00. Under a restrictive monetary policy, the APV would be $86,674, and Centralia would begin operations. On the other hand, an expansionary policy would cause the APV to become an even more negative −$186,464.

Centralia believes that the effect from any change in monetary policy will be known in a year's time. Thus it decides to put its plans on hold until it learns what the ECB decides to do. In the meantime, Centralia can obtain a purchase option for a year on the parcel of land in Zaragoza on which it would build the manufacturing facility by paying the current landowner a fee of €5,000, or $6,600.

[13] It may be helpful to review the discussion on political risk in Chapter 16.

The situation described is a classic example in which real options analysis is useful in evaluating a capital expenditure. In this situation, the purchase option of €5,000 represents the option premium of the real option and the initial investment of €5,500,000 represents the exercise price of the option. Centralia will only exercise its real option if the ECB decides to follow a restrictive policy that would cause the APV to be a positive \$86,674. The €5,000 seems like a small amount to allow Centralia the flexibility to postpone making a costly capital expenditure until more information is learned. The following example explicitly values the timing option using the binomial options pricing model.

EXAMPLE | 18.4: Valuing Centralia's Timing Option

In this example, we value the timing option described in the preceding example using the binomial options pricing model developed in Chapter 7. We use Centralia's 8 percent borrowing cost in dollars and 7 percent borrowing cost in euros as our estimates of the domestic and foreign risk-free rates of interest. Depending upon the action of the ECB, the euro will either appreciate 10 percent to \$1.45/€1.00 or depreciate 9 percent to \$1.20/€1.00 from its current level of \$1.32/\$1.00. Thus, $u = 1.10$ and $d = 1/1.10. = .91$. This implies that the risk-neutral probability of an appreciation is $q = [(1 + i_d)/(1 + i_f) - d]/(u - d) = [(1.08)/(1.07) - .91]/(1.10 - .91) = .52$ and the probability of a depreciation is $1 - q = .48$. Since the timing option will only be exercised if the APV is positive, the value of the timing option is $C = .52(\$86{,}674)/(1.08) = \$41{,}732$. Since this amount is in excess of the \$6,600 cost of the purchase option on the land, Centralia should definitely take advantage of the timing option it is confronted with to wait and see what monetary policy the ECB decides to pursue.

SUMMARY

This chapter presents a review of the NPV capital budgeting framework and expands the methodology into the APV model that is suitable for analyzing capital expenditures of a MNC in a foreign land.

1. The NPV capital budgeting framework in a domestic context is reviewed. The NPV is the difference between the present value of the cash inflows and outflows. If NPV ≥ 0 for a capital project, it should be accepted.
2. The annual after-tax cash flow formula was thoroughly defined and presented in a number of variations. This was necessary to expand the NPV model into the APV model.
3. The APV model of capital budgeting was developed by analogy to the Modigliani-Miller formula for the value of a levered firm. The APV model separates the operating cash flows from the cash flows due to financing. Additionally, each cash flow is discounted at a rate of discount commensurate with the inherent risk of the individual cash flow.
4. The APV model was further expanded to make it amenable for use by a MNC parent analyzing a capital project of a foreign subsidiary. The cash flows were converted into the parent firm's home currency, and additional terms were added to the model to handle cash flows that are frequently encountered in international capital projects.
5. A case application showing how to apply the APV model was presented and solved.

KEY WORDS

QUESTIONS

1. Why is capital budgeting analysis so important to the firm?
2. What is the intuition behind the NPV capital budgeting framework?
3. Discuss what is meant by the *incremental* cash flows of a capital project.
4. Discuss the nature of the equation sequence, Equations 18.2a to 18.2f.
5. What makes the APV capital budgeting framework useful for analyzing foreign capital expenditures?
6. Relate the concept of *lost sales* to the definition of incremental cash flows.
7. What problems can enter into the capital budgeting analysis if project debt is evaluated instead of the *borrowing capacity* created by the project?
8. What is the nature of a *concessionary* loan and how is it handled in the APV model?
9. What is the intuition of discounting the various cash flows in the APV model at specific discount rates?
10. In the Modigliani-Miller equation, why is the market value of the levered firm greater than the market value of an equivalent unlevered firm?
11. Discuss the difference between performing the capital budgeting analysis from the parent firm's perspective as opposed to the subsidiary's perspective.
12. Define the concept of a real option. Discuss some of the various real options a firm can be confronted with when investing in real projects.
13. Discuss the conditions under which the capital expenditure of a foreign subsidiary might have a positive NPV in local currency terms but be unprofitable from the parent firm's perspective.

PROBLEMS

1. The Alpha Company plans to establish a subsidiary in Hungary to manufacture and sell fashion wristwatches. Alpha has total assets of $70 million, of which $45 million is equity financed. The remainder is financed with debt. Alpha considered its current capital structure optimal. The construction cost of the Hungarian facility in forints is estimated at HUF2,400,000,000, of which HUF1,800,000,000 is to be financed at a below-market borrowing rate arranged by the Hungarian government. Alpha wonders what amount of debt it should use in calculating the tax shields on interest payments in its capital budgeting analysis. Can you offer assistance?
2. The current spot exchange rate is HUF250/$1.00. Long-run inflation in Hungary is estimated at 10 percent annually and 3 percent in the United States. If PPP is expected to hold between the two countries, what spot exchange rate should one forecast five years into the future?
3. The Beta Corporation has an optimal debt ratio of 40 percent. Its cost of equity capital is 12 percent and its before-tax borrowing rate is 8 percent. Given a marginal tax rate of 35 percent, calculate (a) the weighted-average cost of capital, and (b) the cost of equity for an equivalent all-equity financed firm.
4. Zeda, Inc., a U.S. MNC, is considering making a fixed direct investment in Denmark. The Danish government has offered Zeda a concessionary loan of

DKK 15,000,000 at a rate of 4 percent per annum. The normal borrowing rate for Zeda is 6 percent in dollars and 5.5 percent in Danish krone. The load schedule calls for the principal to be repaid in three equal annual installments. What is the present value of the benefit of the concessionary loan? The current spot rate is DKK5.60/$1.00 and the expected inflation rate is 3 percent in the United States and 2.5 percent in Denmark.

5. Delta Company, a U.S. MNC, is contemplating making a foreign capital expenditure in South Africa. The initial cost of the project is ZAR10,000. The annual cash flows over the five-year economic life of the project in ZAR are estimated to be 3,000, 4,000, 5,000, 6,000, and 7,000. The parent firm's cost of capital in dollars is 9.5 percent. Long-run inflation is forecasted to be 3 percent per annum in the United States and 7 percent in South Africa. The current spot foreign exchange rate is ZAR/USD = 3.75. Determine the NPV for the project in USD by:
   a. Calculating the NPV in ZAR using the ZAR equivalent cost of capital according to the Fisher effect and then converting to USD at the current spot rate.
   b. Converting all cash flows from ZAR to USD at purchasing power parity forecasted exchange rates and then calculating the NPV at the dollar cost of capital.
   c. Are the two dollar NPVs different or the same? Explain.
   d. What is the NPV in dollars if the actual pattern of ZAR/USD exchange rates is: $S(0) = 3.75$, $S(1) = 5.7$, $S(2) = 6.7$, $S(3) = 7.2$, $S(4) = 7.7$, and $S(5) = 8.2$?
6. Suppose that in the case application in the chapter the APV for Centralia had been −$60,000. How large would the after-tax terminal value of the project need to be before the APV would be positive and Centralia would accept the project?
7. With regard to the Centralia case application in the chapter, how would the APV change if:
   a. The forecast of $\overline{\pi}_d$ and/or $\overline{\pi}_f$ is incorrect?
   b. Depreciation cash flows are discounted at K_{ud} instead of i_d?
   c. The host country did not provide the concessionary loan?

INTERNET EXERCISES

Many articles on the importance of concessionary financing can be found on the Internet by searching under the keywords *concessionary financing*.

MINI CASE 1

Dorchester, Ltd.

Dorchester, Ltd. is an old-line confectioner specializing in high-quality chocolates. Through its facilities in the United Kingdom, Dorchester manufactures candies that it sells throughout Western Europe and North America (United States and Canada). With its current manufacturing facilities, Dorchester has been unable to supply the U.S. market with more than 225,000 pounds of candy per year. This supply has allowed its sales affiliate, located in Boston, to be able to penetrate the U.S. market no farther west than St. Louis and only as far south as Atlanta. Dorchester believes that a separate manufacturing facility located in the United States would allow it to supply the entire U.S. market and Canada (which presently accounts for 65,000 pounds per year). Dorchester currently estimates initial demand in the North American market at 390,000 pounds, with growth at a 5 percent annual rate. A separate manufacturing facility would, obviously, free up the amount currently shipped to the United States and Canada. But Dorchester believes that this is only a short-run problem. They believe the economic development taking place in Eastern Europe will allow it to sell there the full amount presently shipped to North America within a period of five years.

Dorchester presently realizes £3.00 per pound on its North American exports. Once the U.S. manufacturing facility is operating, Dorchester expects that it will be able to initially price its product at \$7.70 per pound. This price would represent an operating profit of \$4.40 per pound. Both sales price and operating costs are expected to keep track with the U.S. price level; U.S. inflation is forecast at a rate of 3 percent for the next several years. In the U.K., long-run inflation is expected to be in the 4 to 5 percent range, depending on which economic service one follows. The current spot exchange rate is \$1.50/£1.00. Dorchester explicitly believes in PPP as the best means to forecast future exchange rates.

The manufacturing facility is expected to cost \$7,000,000. Dorchester plans to finance this amount by a combination of equity capital and debt. The plant will increase Dorchester's borrowing capacity by £2,000,000, and it plans to borrow only that amount. The local community in which Dorchester has decided to build will provide \$1,500,000 of debt financing for a period of seven years at 7.75 percent. The principal is to be repaid in equal installments over the life of the loan. At this point, Dorchester is uncertain whether to raise the remaining debt it desires through a domestic bond issue or a Eurodollar bond issue. It believes it can borrow pounds sterling at 10.75 percent per annum and dollars at 9.5 percent. Dorchester estimates its all-equity cost of capital to be 15 percent.

The U.S. Internal Revenue Service will allow Dorchester to depreciate the new facility over a seven-year period. After that time the confectionery equipment, which accounts for the bulk of the investment, is expected to have substantial market value.

Dorchester does not expect to receive any special tax concessions. Further, because the corporate tax rates in the two countries are the same—35 percent in the U.K. and in the United States—transfer pricing strategies are ruled out.

Should Dorchester build the new manufacturing plant in the United States?

MINI CASE 2

Strik-it-Rich Gold Mining Company

The Strik-it-Rich Gold Mining Company is contemplating expanding its operations. To do so it will need to purchase land that its geologists believe is rich in gold. Strik-it-Rich's management believes that the expansion will allow it to mine and sell an additional 2,000 troy ounces of gold per year. The expansion, including the cost of the land, will cost \$2,500,000. The current price of gold bullion is \$1,400 per ounce and one-year gold futures are trading at $\$1,484 = \$1,400(1.06)$. Extraction costs are \$1,050 per ounce. The firm's cost of capital is 10 percent. At the current price of gold, the expansion appears profitable: $\text{NPV} = (\$1,400 - 1,050) \times 2,000/.10 - \$2,500,000 = \$4,500,000$. Strik-it-Rich's management is, however, concerned with the possibility that large sales of gold reserves by Russia and the United Kingdom will drive the price of gold down to \$1,100 for the foreseeable future. On the other hand, management believes there is some possibility that the world will soon return to a gold reserve international monetary system. In the latter event, the price of gold would increase to at least \$1,600 per ounce. The course of the future price of gold bullion should become clear within a year. Strik-it-Rich can postpone the expansion for a year by buying a purchase option on the land for \$250,000. What should Strik-it-Rich's management do?

REFERENCES & SUGGESTED READINGS

Ang, James S., and Tsong-Yue Lai. "A Simple Rule for Multinational Capital Budgeting." *The Global Finance Journal* 1 (1989), pp. 71–75.

Booth, Lawrence D. "Capital Budgeting Frameworks for the Multinational Corporation." *Journal of International Business Studies* (Fall 1982), pp. 113–23.

Brealey, Richard A., Stewart C. Myers, and Franklin Allen. *Principles of Corporate Finance,* 9th ed. New York: McGraw-Hill/Irwin, 2008.

Endleson, Michael E. "Real Options: Valuing Managerial Flexibility (A)." *Harvard Business School Note* (March 31, 1994).

Holland, John. "Capital Budgeting for International Business: A Framework for Analysis." *Managerial Finance* 16 (1990), pp. 1–6.

Lessard, Donald R. "Evaluating International Projects: An Adjusted Present Value Approach." In Donald R. Lessard (ed.), *International Financial Management: Theory and Application,* 2nd ed. New York: Wiley, 1985, pp. 570–84.

Luehrman, Timothy A. "Capital Projects as Real Options: An Introduction." *Harvard Business School Note* (March 22, 1995).

Luehrman, Timothy A. "Investment Opportunities as Real Options: Getting Started on the Numbers." *Harvard Business Review* (July–August 1998), pp. 51–67.

Luenberger, David G. "Evaluating Real Investment Opportunities." In Chapter 12, "Basic Options Theory," in *Investment Science*. New York: Oxford University Press, 1998, pp. 337–43.

Modigliani, Franco, and Merton H. Miller. "Corporate Income Taxes and the Cost of Capital: A Correction." *American Economic Review* 53 (1963), pp. 433–43.

Ross, Stephen A., Randolph W. Westerfield, and Jeffrey F. Jaffe. *Corporate Finance,* 8th ed. New York: McGraw-Hill/Irwin, 2008.

Shapiro, Alan C. "Capital Budgeting for the Multinational Corporation." *Financial Management* (Spring 1978), pp. 7–16.