CHAPTER 18 INTERNATIONAL CAPITAL BUDGETING
SUGGESTED ANSWERS AND SOLUTIONS TO END-OF-CHAPTER QUESTIONS AND PROBLEMS

QUESTIONS

1. Why is capital budgeting analysis so important to the firm?

Answer: The fundamental goal of the financial manager is to maximize shareholder wealth. Capital investments with positive NPV or APV contribute to shareholder wealth. Additionally, capital investments generally represent large expenditures relative to the value of the entire firm. These investments determine how efficiently and expensively the firm will produce its product. Consequently, capital expenditures determine the long-run competitive position of the firm in the product marketplace.

2. What is the intuition behind the NPV capital budgeting framework?

Answer: The NPV framework is a discounted cash flow technique. The methodology compares the present value of all cash inflows associated with the proposed project versus the present value of all project outflows. If inflows are enough to cover all operating costs and financing costs, the project adds wealth to shareholders.

3. Discuss what is meant by the *incremental* cash flows of a capital project.

Answer: Incremental cash flows are denoted by the change in total firm cash inflows and cash outflows that can be traced directly to the project under analysis.

4. Discuss the nature of the equation sequence, Equation 18.2a to 18.2f.

Answer: The equation sequence is a presentation of incremental annual cash flows associated with a capital expenditure. Equation 18.2a presents the most detailed expression for calculating these cash flows; it is composed of three terms. Equation 18.2b shows that these three terms are: i) incremental net profit associated with the project; ii) incremental depreciation allowance; and, iii) incremental after-tax interest expense associated with the borrowing capacity created by the project. Note, the incremental "net profit" is not accounting profit but rather net cash actually available for shareholders. Equation 18.2c cancels out the after-tax interest term in 18.2a, yielding a simpler formula. Equation 18.2d shows that the first term in 18.2c is generally called after-tax net operating income. Equation 18.2e yields yet a computationally simpler formula by combining the depreciation terms of 18.2c. Equation 18.2f shows that the first term in 18.2e is generally referred to as after-tax operating cash flow.

5. What makes the APV capital budgeting framework useful for analyzing foreign capital expenditures?

Answer: The APV framework is a value-additivity technique. Because international projects frequently have cash flows not encountered in domestic projects, the APV technique easily allows the analyst to add terms to the model that represent the special cash flows.

6. Relate the concept of *lost sales* to the definition of incremental cash flow.

Answer: When a new capital project is undertaken it may compete with an existing project(s), causing the old project(s) to experience a loss in sales revenue. From an incremental cash flow standpoint, the new project's incremental revenue is the total sales revenue associated with the new project minus the lost sales revenue from the old project(s).

7. What problems can enter into the capital budgeting analysis if project debt is evaluated instead of the *borrowing capacity* created by the project?

Answer: If project debt is greater (less) than the borrowing capacity created by the capital project, and tax shields on the actual new debt are used in the analysis, the *APV* will be overstated (understated) making the project unjustly appear more (less) attractive than it actually is.

8. What is the nature of a *concessionary loan* and how is it handled in the APV model?

Answer: A concessionary loan is a loan offered by a governmental body at below the normal market rate of interest as an enticement for a firm to make a capital investment that will economically benefit the lender. 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 discounted at the MNC's normal domestic borrowing rate. 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. The benefit to the MNC of the concessionary loan is handled in the APV model via a separate term.

9. What is the intuition of discounting the various cash flows in the APV model at specific discount rates?

Answer: The APV model is a value-additivity technique where total value is determined by the sum of the present values of the individual cash inflows and outflows. Each cash flow will not necessarily have the same amount of risk associated with it. To account for risk differences in the analysis, each cash flow is discounted at a rate commensurate with the inherent riskiness of the cash flow.

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?

Answer: The levered firm has a greater market value because less money is taken from the firm by the government in taxes due to tax-deductible interest payments. Thus, there is more cash left for investor groups than when the firm is financed with all-equity funds.

11. Discuss the difference between performing the capital budgeting analysis from the parent firm's perspective as opposed to the project perspective.

Answer: The goal of the financial manager of the parent firm is to maximize its shareholders' wealth. A capital project of a subsidiary of the parent may have a positive NPV (or APV) from the subsidiary's perspective yet have a negative NPV (or APV) from the parent's perspective if certain cash flows cannot be repatriated to the parent because of remittance restrictions by the host country, or if the home currency is expected to appreciate substantially over the life of the project, yielding unattractive cash flows when converted into the home currency of the parent. Additionally, a higher tax rate in the home country may cause the project to be unprofitable from the parent's perspective. Any of these reasons could result in the project being unattractive to the parent and the parent's stockholders.

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.

Answer: A positive APV project is accepted under the assumption that all future operating decisions will be optimal. The firm's management does not know at the inception date of a project what future decisions it will be confronted with because all 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. 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* as 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.

13. Discuss the circumstances 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.

Answer: The project NPV might be negative from the parent firm's perspective when it is positive in local currency terms if all foreign cash flows cannot be legally repatriated to the parent firm. Additionally, if the PPP assumption does not hold, such that the actual future real exchange rate has depreciated in foreign currency terms, the after-tax cash flows will yield less units of home currency from the parent firm's perspective than expected, possibly resulting in a negative NPV.

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,and 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?

Solution: The Alpha Company has an optimal debt ratio of .357 (= $25 million debt/$70 million assets) or 35.7%. The project debt ratio is .75 (= HUF1,800/HUF2,400) or 75%. Alpha will overstate the tax shield on interest payments if it uses the 75% figure because the proposed project will only increase borrowing capacity by HUF856,800,000 (=HUF2,400,000,000 x .357).

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 should one forecast five years into the future?

Solution: $HUF250(1 + .10)^5/(1 + .03)^5 = HUF347.31/\$1.00$.

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.

Solution:

(a) $K = (1 - .40).12 + (.40).08(1 - .35)$

$= .0928$ or 9.28%

(b) A weighted-average cost of capital of 9.28% for a levered firm implies:

$K = .0928 = K_u (1-(.35)(.40))$. Solving for K_u yields .1079 or 10.79%.

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 DKK15,000,000 at a rate of 4 percent per annum. The normal borrowing rate is 6 percent in dollars and 5.5 percent in Danish krone. The loan 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% in the U.S. and 2.5% in Denmark.

Solution:

Year (t)	S_t (a)	Principal Payment (b) DKK	I_t (c) DKK	S_tLP_t (b + c)/(a)	$S_tLP_t/(1 + i_d)^t$
1	5.57	5,000,000	600,000	1,005,386	948,477
2	5.55	5,000,000	400,000	972,973	865,943
3	5.52	5,000,000	200,000	942,029	790,946
		15,000,000			2,605,366

The dollar value of the concessionary loan is $2,678,574 = DKK15,000,000 ÷ 5.60. The dollar present value of the concessionary loan payments is $2,605,366. Therefore, the present value of the benefit of the concessionary loan is $73,208 = $2,678,574 – 2,605,366.

5. Suppose that in the illustrated mini case 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?

Solution: Centralia should not go ahead with its plans to build a manufacturing plant in the Spain unless the terminal value is likely to be large enough to yield a positive APV. The terminal value of the project must be $299,010 in order for the APV to equal zero. This is calculated as follows. Set

$S_T TV_T/(1+K_{ud})^T$ = $60,000. This implies

$TV_T = (\$60{,}000/S_T)(1+K_{ud})^T$

$= (\$60{,}000/.7261)(1.11)^8$

$= €190{,}431.$

6. With regards to the Centralia illustrated mini case in the chapter, how would the APV change if:

a. The forecast of π_d and/or π_f are incorrect?

Answer: A larger or smaller π_d will not have any effect because a change will affect the numerator and denominator of each APV term in an offsetting manner. Note that imbedded in each domestic discount rate is the inflation premium π_d. A larger (smaller) π_f, however, will decrease (increase) the project APV because the foreign currency received will buy less (more) parent country currency upon repatriation.

b. Deprecation cash flows are discounted at K_{ud} instead of i_d?

Answer: The APV would be less favorable because K_{ud} is a larger discount rate than i_d.

c. The host country did not provide the concessionary loan?

Answer: The APV would be less favorable because the project would have to cover a higher finance charge, i.e., there would be no benefit received from below market financing.

MINI CASE ONE: 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?

Suggested Solution to Dorchester Ltd.

Summary of Key Information

The current exchange rate in European terms is $S_o(£/\$)$ = 1/1.50 = .6667.

The initial cost of the project in British pounds is S_oC_o = £0.6667($7,000,000) = £4,666,900.

The U.K. inflation rate is estimated at 4.5% per annum, or the mid-point of the 4%-5% range. The U.S. inflation rate is forecast at 3% per annum. Under the simplifying assumption that PPP holds $\overline{S}_t$ = $.6667(1.045)^t/(1.03)^t$.

The before-tax nominal contribution margin per unit at t=1 is $\$4.40(1.03)^{t-1}$.

It is assumed that Dorchester will be able to sell one-fifth of the 290,000 pounds of candy it presently sells to North America in Eastern Europe the first year the new manufacturing facility is in operation; two-fifths the second year; etc.; and all 290,000 pounds beginning the fifth year.

The contribution margin on lost sales per pound in year t equals $£3.00(1.045)^t$.

Terminal value will initially be assumed to equal zero.

Straight line depreciation over the seven year economic life of the project is assumed: D_t = $1,000,000 = $7,000,000/7 years.

The marginal tax rate, τ, is the U.K. (or U.S.) rate of 35%.

Dorchester will borrow $1,500,000 at the concessionary loan rate of 7.75% per annum. Optimally, Dorchester should borrow the remaining funds it needs, £1,000,000, in pounds sterling because according to the Fisher equation, the real rate is less for borrowing pounds sterling than it is for borrowing dollars:

5.98% or .0598 = (1.1075)/(1.045) - 1.0 versus

6.31% or .0631 = (1.095)/(1.03) - 1.0.

K_{ud} = 15%.

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

Year (t)	$\overline{S}_t$	Quantity	$\overline{S}_t$ x Quantity x \$4.40 x $(1.03)^{t-1}$	Quantity Lost Sales	Quantity Lost Sales x £3.00 x $(1.045)^t$	$\overline{S}_t OCF_t$	$\frac{\overline{S}_t OCF_t(1-\tau)}{(1+K_{ud})^t}$
			(a)		(b)	(a + b)	
			£		£	£	£
1	.6764	390,000	1,160,702	(232,000)	(727,320)	433,382	244,955
2	.6863	409,500	1,273,673	(174,000)	(570,037)	703,636	345,832
3	.6963	429,975	1,397,548	(116,000)	(397,126)	1,000,422	427,566
4	.7064	451,474	1,533,373	(58,000)	(207,498)	1,325,875	492,748
5	.7167	474,048	1,682,524	0	0	1,682,524	543,733
6	.7271	497,750	1,846,053	0	0	1,846,053	518,765
7	.7377	522,638	2,025,613	0	0	2,025,613	494,977
							3,068,576

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	.6764	1,000,000	213,761
2	.6863	1,000,000	195,837
3	.6963	1,000,000	179,404
4	.7064	1,000,000	164,340
5	.7167	1,000,000	150,552
6	.7271	1,000,000	137,911
7	.7377	1,000,000	126,340
			1,168,146

Calculation of the Present Value of the Concessionary Loan Payments

Year (t)	$\overline{S}_t$	Principal Payment	I_t	$\overline{S}_t LP_t$	$\frac{\overline{S}_t LP_t}{(1+i_d)^t}$
	(a)	(b)	(c)	(a) x (b + c)	
		$	$	£	£
1	.6764	214,286	116,250	223,574	201,873
2	.6863	214,286	99,643	215,449	175,654
3	.6963	214,286	83,036	207,025	152,402
4	.7064	214,286	66,429	198,297	131,808
5	.7167	214,286	49,821	189,286	113,605
6	.7271	214,286	33,214	179,957	97,523
7	.7377	214,286	16,607	170,330	83,346
		1,500,000			956,211

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

$$S_o CL_o - \sum_{t=1}^{T} \frac{\overline{S}_t LP_t}{(1+i_d)^t} = £0.6667 \text{ x } \$1{,}500{,}000 - £956{,}211 = £43{,}839$$

Calculation of the Present Value of the Interest Tax Shields
from the $1,500,000 Concessionary Loan

Year (t)	$\overline{S}_t$ (a)	I_t (b) $	$\overline{S}_t \tau I_t$ (a x b x τ) £	$\frac{\overline{S}_t \tau I_t}{(1+i_d)^t}$ £
1	.6764	116,250	27,521	24,850
2	.6863	99,643	23,935	19,514
3	.6963	83,036	20,236	14,897
4	.7064	66,429	16,424	10,917
5	.7167	49,821	12,497	7,501
6	.7271	33,214	8,452	4,581
7	.7377	16,607	4,288	2,098
				84,357

Calculation of the Present Value of the Interest Tax Shields

from the £1,000,000 Bond Issue

Year (t)	Outstanding Loan Balance	Principal Payment	Interest Payment	$\frac{\tau I_t}{(1+i_d)^t}$
	£	£	£	£
1	1,000,000	0	107,500	33,973
2	1,000,000	0	107,500	30,675
3	1,000,000	0	107,500	27,698
4	1,000,000	0	107,500	25,009
5	1,000,000	0	107,500	22,582
6	1,000,000	0	107,500	20,390
7	1,000,000	1,000,000	107,500	18,411
				178,738

Without considering the terminal value of the project, the APV of the project is negative:

APV = £3,068,576 + 1,168,146 + 43,839 + 84,357 + 178,738 - 4,666,900 =
-£123,244.

Dorchester should not go ahead with its plans to build a manufacturing plant in the U.S. unless the terminal value is likely to be large enough to yield a positive APV. The terminal value of the project must be $444,397 in order for the APV to equal zero. This is calculated as follows. Set

$S_T TV_T/(1+K_{ud})^T$ = £123,244. This implies

$TV_T = ($£123,244$/S_T)(1+K_{ud})^T$

= (£123,244/.7377)$(1.15)^7$

= $444,397.

Since the terminal value is expected to be substantial, and the initial cost of the project is $7,000,000, it appears likely that the terminal value will be sufficient to yield a positive APV. Thus, Dorchester should go ahead with its plans to build a manufacturing plant in the U.S.

MINI-CASE: 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 $500,000. The current price of gold bullion is $425 per ounce and one-year gold futures are trading at $450.50 = $425(1.06). Extraction costs are $375 per ounce. The firm's cost of capital is 10%. At the current price of gold, the expansion appears profitable: NPV = ($425 – 375) x 2,000/.10 - $500,000 = $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 $390 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 $460 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 $25,000. What should Strik-it-Rich's management do?

Suggested Solution to Strik-it-Rich Gold Mining Company

There is considerable risk in expanding operations at the present time, even though the NPV based on the current price of gold is a positive $500,000. If the price of gold falls to $390 per ounce, the NPV = ($390 – 375) x 2000/.10 - $500,000 = -$200,000. On-the-other-hand, if the price of gold increases to $460, the NPV is a very attractive NPV= ($460 – 375) x 2000/.10 - $500,000 = $1,200,000. The purchase option for $25,000 on the land is a relatively small amount to have the opportunity to postpone the decision until additional information is learned. Obviously, Strik-it-Rich's management will only invest if the NPV is positive. The risk-neutral probability of gold increasing to $460 per ounce is:

$$q = (F_0 - S_0 \cdot d)/S_0(u - d) = (450.50 - 390)/(460 - 390) = .8643.$$

Thus, the value of the timing option to postpone the decision one year is:

$$C = .8643(\$1{,}200{,}000)/(1.06) = \$978{,}453.$$

Since this amount is substantially in excess of the $25,000 cost of the purchase option on the land, Strik-it-Rich's management should definitely take advantage of the timing option it is confronted with to wait and see what the price of gold is in one year before it makes a decision to expand operations.