

Chapter 21 International Capital Budgeting

Quiz Questions

True-False Questions

- _____ 1. Net Present Value analysis assumes that the risk of the project is constant.
- _____ 2. ANPV and WACC are essentially substitutes; neither is superior to the other.
- _____ 3. The sum of a project's profits, when accumulated over time without taking time value into account, is identical to the sum of the project's cash flows.
- _____ 4. The sum of a project's investments and disinvestments in working capital, when accumulated over time without taking time value into account, is zero.
- _____ 5. When the firm has the choice between either gradually depreciating an investment or charging the investment off entirely to the year's profit and loss account, the first choice is generally recommendable. It does not affect the total amount paid in taxes (over the project's entire life), and it avoids unnecessary fluctuations in profits.
- _____ 6. When applying NPV, you should take great care in reallocating the firm's general overhead, and charge a fair portion of this overhead to the new project—for instance, proportionally with sales or direct costs.
- _____ 7. When valuing a project, you should not include in the cash flows the (arm's length) profits made by other business units on their sales to the new unit. That is, the project should be viable even when it must pay normal (arm's length) prices for the components it buys.
- _____ 8. Adjusted NPV contains corrections for qualitative aspects that were ignored in the first-pass NPV calculations.
- _____ 9. Since borrowing reduces corporate taxes, one should always compute the tax savings ($\text{borrowing capacity} \times \text{interest rate} \times \text{tax rate}$), and add their present value to the first-pass NPV.
- _____ 10. The WACC correctly measures the gain to the shareholders from undertaking a project, if and only if (1) the project is either a perpetuity or a one-period venture; (2) the tax shield is always fully used; and (3) all gains accrue to the shareholders.
- _____ 11. Exports occur through a dependent agent or through a branch, while operating through a subsidiary falls into the category of international marketing.
- _____ 12. A firm that is very good at marketing will often become a franchisee; similarly, a firm that is very good at developing a new technology or that possesses a valuable brand name will typically become a licensee.
- _____ 13. The licensor or franchiser typically receives a stated fraction of the project's profits.
- _____ 14. Having a foreign branch is like having a dependent agent abroad, except that the foreign operations are incorporated as a separate company.
- _____ 15. The incremental value principle says that since the gains from tax planning and treaty shopping are unambiguously related to the project, these gains should be considered in the decision to accept or reject.
- _____ 16. When conducting an NPV analysis, one should be as realistic as possible, and subtract, for example, the license fees, interest payments and amortization of intra-company loans, and management fees from the project's cash flows.
- _____ 17. Since the money paid to bank(s) to service loan(s) does not accrue to the shareholders, one should subtract these payments from the operational cash flows before computing the NPV.
- _____ 18. A sound rule of thumb is that the company should borrow in a weak currency. The reason is two-fold. First, the firm can expect a capital gain

when the loan is paid back. Second, the high interest payments mean that there is a large interest tax shield.

- _____ 19. To account for expropriation risk, one simply deducts the insurance premium (after taxes) because this premium is equal to the market's risk-adjusted expected cost of expropriation.
- _____ 20. The best way to account for transfer risk is to add a risk premium to the discount rate. The next best way is to subtract the expected losses on blocked funds from the operating cash flows.
- _____ 21. Leading and lagging are ways to speculate on changes in transfer prices.

Ans. 1. true; 2. false; 3. true; 4. true; 5. false: you lose time value by voluntarily speeding up taxes; 6. false: only incremental overhead matters (the increase in overhead caused by the project); 7. false: We use the NPV rather than the ill-defined "arm's length" profits. The discounting implicitly subtracts the normal return on investment and normal reward for risk from the supplying units cash flows. If the NPV of the supplying units cash flows is truly equal to zero, they will not affect the project NPV. So no harm is done by including them. If, on the other hand, the supplying units cash flows do have a positive NPV, we clearly have to include them; 8. false; 9. false; 10. false; 11. false; 12. false; 13. false; 14. false; 15. false; 16. false: the license payments have to be added back to the project cash flows; 17. false: one decides on the basis of a full-equity analysis; 18. false: in terms of risk-adjusted expectations, there is no difference in the currency of borrowing if the spot and forward markets are in equilibrium and the capital gains tax is the same as the tax on interest income; 19. false; 20. false; 21. false.

Additional Quiz Questions

Q1. What are the reasons why the tax savings from corporate borrowing are often smaller than the present value of (borrowing capacity \times borrowing rate \times tax rate)?

- A1.
- Not all of the tax shield may be used if the earnings before interest are not large enough.
 - There is a loss of time value when an interest tax shield is carried forward.
 - The formula only looks at corporate taxes and ignores the total tax burden.
 - Generally, part of the tax subsidy will accrue to the shareholders and part to the bondholders, but just how much each will receive is unknown.

Q2. Why does a firm often combine, for example, exports, foreign marketing, and licensing—rather than choosing only one of the above methods of operations?

- A2. Each mode of foreign activity is not mutually exclusive, and a company may create synergies by combining various modes. These synergies include: reducing the total tax burden, reducing political risk, and distributing the risk and the revenues.

Q3. What are the main differences between an independent agent and a dependent agent? A dependent agent and a branch? A branch and a subsidiary? A subsidiary and a joint venture?

A3.

	Independent agent	Dependent agent	Branch	WOS	JV
Type of activity	Sells units on its own account	Sells on account of firm	Produces and/or sells for the parent firm	Produces and/or sells on its own account	Produces and/or sells on its own account
Company legal present in host country	No	No	Yes, but not separate from the parent	Yes, as a separate company that is owned by the parent firm	Yes, but as a separate company with two or more parents

- Q4. Why is it recommendable to separate the analysis of intra-company financial arrangements from:
- The analysis of the operations?
 - The analysis of the effects of external financing?
- A4. (a) Intra-company financial arrangements should be examined separately from the operational aspects because the royalties or interest on an intra-company loan are a "cost" to the subsidiary, but at the same time, income to the parent. Also, royalties and interest payments result in lower host country taxes, but greater taxes on home country income.
- (b) 1) Tax planning is complex and technical; 2) the assumptions concerning the size and timing of dividends may be tenuous and the potential closing of tax loopholes may eliminate any savings from tax planning; and, 3) tax savings should only be viewed as a welcome boon, and not the element which will make or break an NPV calculation.
- Q5. Describe how the pro-active and reactive management of transfer risk differ.
- A5. If a country with foreign country reserve problems is going to begin blocking some forms of remittances, it is helpful if a company has already established a tradition of proactive transfer risk management using techniques like leading and lagging or using a bank as a front for a loan. The reason is that once capital controls have been imposed, if a company changes its remittance policy, the host government will recognize the changes as tactics for avoiding controls and disallow transfers of funds. Likewise, when a host country blocks some or all payments, you will no longer have the opportunity to dress up an intra-company loan as a loan from a bank. Thus, this has to be done pro-actively.
- Q6. What cash flows are not shown in the projected profit-and-loss accounts for the project, but should nevertheless be taken into account when doing an NPV analysis?
- A6. Depreciation should be added back because it is not a real cost, and the initial costs and the actual production costs should be recognized as they occur.
- Q7. When the host and home capital markets are integrated, why is it, in principle, immaterial whether one conducts the analysis in terms of the host currency or in terms of the home currency? In practice, which of the two approaches is most convenient, and why?
- A7. In the absence of capital markets, arbitrage and portfolio adjustment equates prices, discount rates and values. In practice, it is simplest to discount the cash flows at the host-country risk-adjusted cost of capital and convert them at the spot rate.

Exercises

- E1. Consider Example 21.2. Suppose that intra-company transactions represent one-fourth of a project's variable costs, and every delivery valued at the arm's-length price of 100 pesetas increases the profits of the supplying unit by 50 pesetas; that is, variable costs are half of the transfer price. Additional deliveries of coating material will not require any additional investment, nor will they affect the company's overhead. Evaluate the profits the parent makes on its intra-company sales, and incorporate them into the NPV analysis.

To take into account leads and lags (investments in working capital), assume that:

- The supplying unit ships the coating, on average, six months before the subsidiary sells its final product (that is, shipment occurs at times 1, 2, ..., 5).
- Production of the coating consists of grinding and mixing, and takes virtually no time; the supplying unit usually has about one month's worth of raw material in inventory, and pays its own suppliers thirty days after delivery. Workers are paid every week. Thus, the supplying unit's cash outflows also take place at times 1, 2, ..., 5.
- The new business unit pays sixty days after delivery; taking into account one month for the actual shipment, this means that the supplying unit is paid at times 1.25, 2.25, ..., 5.25.

- A1. The data imply the following cash flows from the sales to the new unit:

**Present value of the additional cash flows generated
in supplying the business unit**

Reporting year	(a) Sales	(b) Variable costs	(c) Over-head	(d) Depre-ciation	(e) Taxable	(f) Tax (35%)
1	65	33	0	0	33	11
2	100	50	0	0	50	18
3	110	55	0	0	55	19
4	60	30	0	0	30	11
5	30	15	0	0	15	5
PV	218	109				38

Sales of coating by the supplying unit to the proposed new business unit represent one-fourth of the project's variable costs; that is, (a) is one-fourth of column (b) from Table 21.1. The variable costs of producing this coating are half the transfer price, that is, (b) = (a)/2, (e)=(a) - (b) - (c) - (d), and (f) = (e) × 0.35.

On the basis of the figures in this exhibit, value the profits the parent makes on its intracompany sales as follows:

$$\begin{aligned} \text{NPV} &= \sum_{t=1}^5 \frac{\text{sales}_t}{1.2^{(t+0.25)}} - \sum_{t=1}^5 \frac{\text{variable costs}_t}{1.2^t} - \sum_{t=1}^5 \frac{\text{taxes}_t}{1.2^{(t+1)}} \\ &= 218 - 109 - 38 = \text{ESP } 71. \end{aligned}$$

- E2. Again consider Example 21.2. We add a second interaction. Specifically, assume that Weltek UK is currently exporting to Spain, via an independent agent. If Weltek

chooses to continue exporting instead of setting up production in Spain, unit variable costs will be higher (due to transportation cost, tariffs, etc.); and sales will be lower than expected because the agent is not as interested in promoting Weltek's goods as Weltek itself. On the other hand, no investments in fixed assets and marketing organization are required if exporting remains the mode of operation, and exporting does not create any extra overhead. Weltek's profits from exporting, and the corresponding taxes, are presented below.

	(a) Sales	(b) Variable costs	(c) Overhead	(d) Depre- ciation	(e) Taxable	(f) Tax (35%)
Year t						
1	420	231	0	0	189	66
2	551	303	0	0	248	87
3	463	255	0	0	108	73
4	243	134	0	0	109	38
5	128	70	0	0	58	20
PV	1,169	673	0	0	0	153

$$(e) = (a) - (b) - (c) - (d); (f) = (e) \times 0.35.$$

Due to shipping delays and the increased inventory levels needed in view of the distance, production for exports takes place six months before the moment of sale to the final Spanish customer (that is, at times 1, 2, ..., 5). Production costs lead production by three months. Compute the PV of the export profits lost when the project is undertaken, and decide whether Weltek should still consider direct investment in Spain. Use a 20 percent cost of capital.

A2. The present values of the cash flows are:

$$PV = \sum \frac{\text{sales}_t}{1.20^t} - \sum \frac{\text{variable costs}_t}{1.2^{(t-0.25)}} - \sum \frac{\text{tax}_t}{1.20^{(t+1)}} = 1169 - 673 - 153 = 343.$$

Now evaluate the project. The true NPV of the incremental cash flows equals (in millions of ESP)

– The NPV of the cash flows realized in Spain	-13
– Plus the PV of the profits Weltek makes at home,	71
– Minus the PV of the profits Weltek loses by no longer exporting	<u>-343</u>
Total:	-285

Thus, under this modified scenario, the investment project is no longer profitable.

E3. An Andorra company, Walden Inc., considers a proposal to produce and sell market inverters in Prisionia. The Prisionian dollar (PRD) is fully convertible into any OECD currency, and the country's capital market is unrestricted and well-integrated with western markets. The life of the project is three years. The initial investment consists of land (PRD 1,000) with an expected liquidation value of PRD 1,100; plant and equipment, and entry costs equal PRD 6,000, and are to be depreciated at 66 percent in year 1, 33 percent in year 2, and 1 percent in year 3. Estimated figures for sales, variable costs, and overhead are as follows:

Book year	(a1) Sales	(a2) Sale of the land	(b) Variable costs	(c) Overhead	(d) Depre- ciation	(e) Taxes
1	5,500	—	2,500	1,000	3,960	-784
2	10,000	—	4,200	1,200	1,980	1,048

3	12,800	—	5,600	1,300	60	2,336
4	—	1,100	—	—	—	400

* proceeds from the sale of the land

Sales occur, on average, in the middle of the year; variable costs are disbursed one month earlier, and customers pay three months later. Overhead and taxes are paid in the middle of the year. The investment occurs in the middle of year 0, and liquidation occurs in the middle of the fourth year. The discount rate is 15 percent for the operating cash flows, and 10 percent for the investment itself. Is this a viable proposal?

$$\begin{aligned}
 \text{A3.} \quad & \frac{\text{investment}}{1.15^{0.5}} = <6,674.24> \\
 & \sum_{t=1.75}^{3.75} \frac{\text{sales}}{1.15^t} = 18,694.30 \\
 & \sum_{t=1.25}^{3.25} \frac{\text{varcost}}{1.15^t} = <8,516.90> \\
 & \sum_{t=1.5}^{3.5} \frac{\text{overhead} + \text{taxes}}{1.15^t} = <3,989.60> \\
 & \frac{\text{sale land} - \text{tax}}{1.15^{4.5}} = \underline{373.21} \\
 & \text{NPV} = -113.23 < 0
 \end{aligned}$$

Mind-Expanding Exercises

- ME1. Consider a firm with a healthy cash flow but very low profits—because, for example, because of high depreciation allowances. Your boss argues that such a firm should probably borrow in a strong (low-interest) currency, because the high tax shield from weak-currency loans is more likely to be lost than the low tax-shield from strong-currency loans. Is this analysis complete?
- A1. No. The initial interest payments may be low, but for more distant dates the home-currency value of the service payments (including amortization) from a strong-currency loan is expected to go up and create a correspondingly large potential tax shield. A firm with low accounting profits may not be able to fully and immediately use these tax shields, especially if amortization comes in one big payment at the end. Thus, it is difficult to come up with a general rule as to which currency is the best choice in this instance.
- ME2. Denote the initial investment by I_0 , the operating cash flows by OC_t , the loan by D_0 , and the service payments on this loan by $Serv_t$. The standard NPV is computed as:

$$\sum_{t=T_1}^{t=T_N} \frac{OC_t}{(1+R)^t} - I_0.$$

- (a) Assume zero taxes and no uncertainty. One could, conceivably, compute an NPV from the shareholders' point of view by considering the cash flows after interest payments and the initial investment over and above the amount borrowed:

$$\sum_{t=T_1}^{t=T_N} \frac{(OC_t - Serv_t)}{(1+R)^t} - (I_0 - D_0).$$

Explain why, with zero taxes and no uncertainty, this produces the same answer as a standard NPV analysis. (Hints: (1) How does one compute the PV of a sum (or difference) of two risk-free cash flows? (2) What is the link between the PV of the service payments and the amount borrowed, D_0 ?)

- (b) Does uncertainty affect this conclusion?
 (c) Does the introduction of taxes affect this conclusion?

A2. (a) Value additivity means that:

$$\sum_{t=T_1}^{t=T_N} \frac{(OC_t - Serv_t)}{(1+R)^t} = \sum_{t=T_1}^{t=T_N} \frac{OC_t}{(1+R)^t} - \sum_{t=T_1}^{t=T_N} \frac{Serv_t}{(1+R)^t}.$$

Moreover, $\sum_{t=T_1}^{t=T_N} \frac{Serv_t}{(1+R)^t} = D_0$. Thus, both approaches are identical:

$$\sum_{t=T_1}^{t=T_N} \frac{(OC_t - Serv_t)}{(1+R)^t} - (I_0 - D_0) = \sum_{t=T_1}^{t=T_N} \frac{(OC_t)}{(1+R)^t} - I_0.$$

- (b) No, as long as the operating cash flows are not affected by financial distress. When there is uncertainty, the risks of OC_t and of $Serv_t$ are likely to be different, which implies that the correct discount rate depends on whether the series being discounted is OC_t or $Serv_t$ or $(OC_t - Serv_t)$. However, when the operating cash flows are not affected by financial distress, value additivity still holds, and the amount D_0 is still equal to the present value of the service payments. Thus,

$$\begin{aligned} PV(OC_t - Serv_t) - (I_0 - D_0) &= [PV(OC_t) - PV(Serv_t)] - (I_0 - D_0) \\ &= [PV(OC_t) - D_0] - (I_0 - D_0) \\ &= PV(OC_t) - I_0 \\ &= \text{Standard NPV} \end{aligned}$$

- (c) Yes. When there are taxes, one has to consider the effect of corporate and personal taxes on the cash flows accruing to the shareholders. That is, the annual cash flow to the shareholder is, in general, equal to $(OC_t - Serv_t + tax\ effects_t)$. Thus, with corporate and personal taxes:

$$PV(OC_t - Serv_t + tax\ effects_t) - (I_0 - D_0) = \text{standard NPV} + PV(tax\ effects_t).$$

Chapter 22 Exchange Risk and Capital Segmentation

Quiz

True-False Questions

- _____ 1. The entire NPV analysis can be conducted in terms of the host currency if money markets and exchange markets are fully integrated with the home market.
- _____ 2. The entire NPV analysis can be conducted in terms of the host currency if money markets, stock markets, and exchange markets are fully integrated with the home market.
- _____ 3. Forward rates can be used as the risk-adjusted expected future spot rates to translate the host-currency cash flows into the home currency. The home currency cash flows can then be discounted at the home-currency discount rate, if money markets and exchange markets are fully integrated with the home market.
- _____ 4. Regardless of the degree of market integration, the host-currency expected cash flows can always be translated into the home currency (by multiplying them by the expected spot rate), and then discounted at the home-currency discount rate.
- _____ 5. Regardless of the degree of market integration, the host-currency expected cash flows can always be translated into expected cash flows expressed in home currency. The home-currency cash flows can then be discounted at the home-currency discount rate that takes into account all risk.
- _____ 6. If you use the forward rate as the risk-adjusted expected spot rates, there is no need to worry about the dependence between the exchange rate and the host-currency cash flows.
- _____ 7. If markets are integrated and you translate at the forward rate, the cost of capital need not include a risk premium for exchange rate exposure.
- _____ 8. If markets are integrated and you translate at the forward rate, the cost of capital need not include a risk premium for exposure to the host-currency exchange rate to any currency.
- _____ 9. If you discount expected cash flows that are already expressed in home currency, the cost of capital should include a risk premium for exposure to the host-currency exchange rate.
- _____ 10. If you discount expected cash flows that are already expressed in home currency, the cost of capital should include a risk premium for exposure to all relevant exchange rates.
- _____ 11. If you translate at the forward rate, you can entirely omit exchange rate expectations from the NPV procedure.
- _____ 12. Exchange rate risk premia are sizeable. In fact, they are about as large as the (world) market risk premium.
- _____ 13. A highly risk-averse investor will accept risk only if he or she is certain to be compensated for this risk.
- _____ 14. A highly risk-averse investor will never select a high-risk portfolio.
- _____ 15. A risk-averse investor will select a high-variance portfolio only if the expected excess return is sufficiently high.
- _____ 16. A risk-averse investor will select a low-return portfolio only if the variance is sufficiently low.
- _____ 17. A particularly risk-averse investor will always select a low-return portfolio. This is because low return means low risk, and because the investor does not want to bear a lot of risk.

Ans. 1. false; 2. true; 3. true; 4. false: this statement ignores the covariance term; 5. true; 6. false; 7. false: there may still be some exposure to other exchange rates; 8. false; 9.

true; 10. true; 11. false; 12. false; 13. false: "certain" is nonsense; 14. false; 15. true; 16. true; 17. false

True-False Questions

Assume that money markets and exchange markets are free and the host-currency cash flow is risk-free.

- _____ 1. You can translate at the expected spot rate and discount at a risk-adjusted home-currency cost of capital.
- _____ 2. You can translate at the forward rate, and discount at a home-currency rate that takes into account exchange risk.
- _____ 3. You can translate at the forward rate, and discount at the risk-free home-currency rate.
- _____ 4. You can discount the host-currency cash flows at the foreign risk-free rate, and then translate the result at the current spot exchange rate.
- _____ 5. You can discount the host-currency cash flows at the foreign risk-free rate, and then translate the result at the expected future spot exchange rate.
- _____ 6. You can discount the host-currency cash flows at the foreign risk-free rate, and then translate the result at the forward exchange rate.
- _____ 7. If access to forward markets or foreign and domestic money markets is restricted, then the true value is always overstated if the foreign currency cash flow is translated at the forward exchange rate and then discounted at the domestic risk-free rate.

Ans. 1. true; 2. false; 3. true; 4. true; 5. false; 6. false; 7. false.

Additional Quiz Questions

Q1. Suppose that you observe an efficient portfolio. There are the two methods with which you can infer the degree of risk-aversion of the investor who selects this particular portfolio. What are these two methods?

- A1. 1) By looking at how much the investor invests in the market portfolio and how much he invests in the risk-free asset.
- 2) The ratio of expected excess return to portfolio variance or the ratio of excess return over the covariance of the portfolio return with any individual asset.

Q2. What's wrong with the following statement: "The CAPM says that the expected return on a given stock j is equal to the best possible replication one can obtain using the risk-free assets and the set of all risky assets (other than stock j)."

A2. The statement should read: "The CAPM says that the expected return on a given stock j is equal to the best possible replication one can obtain using the risk-free assets and the market portfolio of all risky assets."

Q3. Below, we reproduce some equations from the derivation of the CAPM. Equation [1] is the efficiency criterion. Equation [4] is the CAPM. Explain how and (especially) *why* the intermediary equations are derived.

$$\frac{E(\tilde{r}_j - r)}{\text{cov}(\tilde{r}_j, \tilde{r}_m)} = \theta, \quad \text{for all risky assets } j = 1, \dots, N \quad [1]$$

$$E(\tilde{r}_j - r) = \theta \text{ cov}(\tilde{r}_j, \tilde{r}_m) = [\theta \text{ var}(\tilde{r}_m)] \frac{\text{cov}(\tilde{r}_j, \tilde{r}_m)}{\text{var}(\tilde{r}_m)} = [\theta \text{ var}(\tilde{r}_m)] \beta_j \quad [2]$$

$$\sum_{j=1}^N x_j E(\tilde{r}_j - r) = \theta \sum_{j=1}^N x_j \text{cov}(\tilde{r}_j, \tilde{r}_m) = \theta \text{cov}\left(\sum_{j=1}^N x_j \tilde{r}_j, \tilde{r}_m\right) = \theta \text{cov}(\tilde{r}_m, \tilde{r}_m) \quad [3]$$

$$E(\tilde{r}_j) - r = \beta_j (E(\tilde{r}_m) - r) \quad [4]$$

A3. See the text on page 594.

Q4. Suppose investors from a country have access to a large set of foreign stocks, and that foreign investors can also buy stocks from that country. Which of the following statements is (are) correct?

- The single-market CAPM, where the market portfolio is measured by the index of all stocks issued by local companies, is wrong.
- The single-market CAPM, where the market portfolio is measured by the index of all stocks held by local investors, is wrong.
- The single-market CAPM, where the market portfolio is measured by the index of all stocks held by local investors, is formally correct but not fit for practical use, because the correct index is not readily observable.
- The single-market CAPM, where the market portfolio measured by the index of all stocks worldwide, is correct provided that there is a unified world market for all stocks.
- The single-market CAPM, where the market portfolio is measured by the index of all stocks worldwide, is correct provided that there is no (real) exchange risk.
- The international CAPM, containing the world market portfolio of all stocks and bonds is correct if there is a well-integrated world market and if all exchange risk is real.

A4. (a) is correct when it says it is wrong; (b) is incorrect when it says it is wrong; (c) is true; (d) is false (ignores real exchange risk issue); (e) is true; (f) false.

Exercises

E1. Suppose that you have the following data:

$E(\tilde{r}_j - r)$	(co)variance risks	
0.03	$\text{var}(\tilde{r}_1) = 0.04$	$\text{cov}(\tilde{r}_1, \tilde{r}_2) = 0.02$
0.04	$\text{cov}(\tilde{r}_2, \tilde{r}_1) = 0.02$	$\text{var}(\tilde{r}_2) = 0.06$

Asset 0 is the (domestic) risk-free asset, and asset weights in a portfolio are denoted as x_j , where $j = 0, \dots, 2$. Which of the following portfolios is efficient, and if the portfolio is efficient, what is the investor's degree of risk aversion?

- $x_0 = 0, x_1 = 0.4, x_2 = 0.6$.
- $x_0 = 0, x_1 = 0.6, x_2 = 0.4$.
- $x_0 = 0, x_1 = 0.5, x_2 = 0.5$.
- $x_0 = 0.2, x_1 = 0.4, x_2 = 0.4$.
- $x_0 = 0.5, x_1 = 0.25, x_2 = 0.25$.
- $x_0 = -1, x_1 = 1, x_2 = 1$.
- $x_0 = 1, x_1 = 0, x_2 = 0$.
- $x_0 = 2, x_1 = -0.5, x_2 = -0.5$.

A1.

	$\frac{E(\tilde{r}_1 - r)}{\text{cov}(\tilde{r}_1, \tilde{r}_p)}$	$\frac{E(\tilde{r}_2 - r)}{\text{cov}(\tilde{r}_2, \tilde{r}_p)}$
(a)	1.071	0.909
(b)	0.938	1.111

(c)	1.000	1.000
(d)	1.250	1.250
(e)	2.000	2.000
(f)	5.000	5.000
(g)	0.000	0.000
(h)	-1.000	-1.000

Portfolios (a) and (b) are inefficient. Portfolio (c) is efficient, and is held by the investor with relative risk aversion equal to unity; (c) is also the tangency portfolio of risky assets. Portfolios (d), (e), and (f) are efficient, because they consist of positive combinations of the tangency portfolio of risky assets and the risk-free asset. Portfolio (g) is efficient, and corresponds to infinite risk aversion. Portfolio (h) is inefficient: the tangency portfolio is sold short rather than held long.

- E2. Return to the example discussed in Chapter 21, of Weltek UK, which is considering an investment in Spain. Suppose that Spain has reverted to its pre-1970 policies, and does not allow its residents to buy foreign assets; nor are foreigners allowed to buy Spanish shares in the stock market. Moreover, Spanish interest rates are set by the government. Local industry is heavily protected, and trade with the rest of the OECD is minimal. Foreign direct investment is permitted but only after obtaining a license. From our previous discussion, we determine that we must use approach 1 (expected spot rates, etc.). We make one possible set of assumptions.

Assumption 1:

Expected Spot Rates. The ESP is deemed to be initially overvalued, which implies an expected devaluation of 12 percent either this or next year. On top of this, we expect a further depreciation by about 3 percent *p.a.* to reflect Spain's higher expected inflation rate relative to the UK.

Year	0	1	2	3	4	5	6
a) Lagged adjustment	1	0.940	0.890	0.890	0.890	0.890	0.890
b) Forecast	1	0.913	0.833	0.810	0.787	0.764	0.706

Line a) models the expected 12 percent devaluation in years 1 or 2 by two consecutive 6 percent devaluations. The lagged adjustment would be the forecast if, as of year 0, Spain's inflation rate were equal to the UK's inflation rate. But Spain's future inflation rate is expected to be 5 percent *p.a.*, versus only 2 percent in the UK. In line b) we therefore add the effect of differences in the expected future inflations by multiplying each year's line (a) number by $(1.02/1.05)^T$.

Assumption 2:

Covariance Risk of ESP Cashflows with the Exchange Rate. Because of trade barriers, the exchange rate has no impact on the ESP cash flows. Thus, we can set the covariance equal to zero. The expected GBP cash flows are then equal to the ESP expected cash flow times the expected exchange rate.

Assumption 3:

Cost of Capital. The cost of capital is estimated at 17 percent, close to risk-free rate. This is because the Spanish economy is (assumed to be) very isolated from the rest of the world, implying that neither the cash flows (in pesetas) nor the GBP/ESP exchange rate is correlated with the OECD market portfolio.

Compute the NPV of Weltek UK's investment in Spain.

- A2. To compute the NPV, use Table 21.1 to first convert the ESP value of each cell in the table into GBP at the expected future spot rate; and then we compute present values. The following exhibit summarizes the resulting GBP cash flows. The NPV is:

$$1634 - 37 - 653 - 235 - 174 - \frac{700}{1.12^{(0.5)}} = -52. \bullet$$

	(a1)	(a2)	(b)	(c)	(d)	(e)	(f)
	Sales	Sale of land	Variable costs	Over-head	Depre-ciation	Taxable	Tax (35%)
year t							
1	593	—	237	96	110	151	53
2	840	—	336	92	101	311	109
3	897	—	358	95	98	346	121
4	476	—	190	97	95	94	33
5	232	—	93	99	93	-53	-18
6	—	93	—	—	—	22	8
PV	1,634	37	653	234	247	174	174

ESP data are the same as in Exhibit 1 of Chapter 21. The GBP values in the current exhibit are computed by multiplying the ESP cash flows for each year T by the exchange rate forecast given in the assignment. (e) = (a) - (b) - (c) - (d) ; (f) = (e) \times 0.35. Sales in year 6 reflect the sale of the land.

- E3. Suppose the capital markets of the following three countries are well integrated: North America (with the dollar), Europe (with the ECU), and Japan (with the yen). Suppose that you choose the yen as the reference currency.
- Why does the average investor care about the JPY/USD and JPY/ECU exchange rates (besides how it relates to how his wealth is measured in JPY)?
 - What moments are needed in a mean-and-(co)variance framework, to summarize the joint distribution? Which of these are affected by the portfolio choice?
- A3. (a) Investors need the exchange rates to translate foreign returns into yens. In addition, American investors will worry about the JPY/USD exchange rate (because they care about their wealth as measured in USD), and Europeans will worry about the JPY/ECU exchange rate (because they care about their wealth as measured in ECU). Thus, the average investor cares about world market return (in JPY) and the changes in the JPY/USD and JPY/ECU exchange rates.
- $E(\tilde{r}_w)$, $\text{var}(\tilde{r}_w)$, $\text{cov}(\tilde{r}_w, \tilde{s}_{\text{JPY/USD}})$, $\text{cov}(\tilde{r}_w, \tilde{s}_{\text{JPY/ECU}})$, $E(\tilde{s}_{\text{JPY/USD}})$, $E(\tilde{s}_{\text{JPY/ECU}})$, $\text{var}(\tilde{s}_{\text{JPY/USD}})$, and $\text{var}(\tilde{s}_{\text{JPY/ECU}})$. The first four are affected by an individual's portfolio choice.
- E4. Suppose that your assistant has run a market-model regression for a company that produces sophisticated drilling machines, and finds the following results (t-statistic in parentheses):

$$r_j = \alpha + \beta r_m + \gamma s + e_j$$

$$r_j = 0.002 + 0.56 r_m + 4.25 s + e_j$$

(0.52) (1.25) (2.06)

Your assistant remarks that, as the estimated beta is insignificant, the true beta is zero. The exposure, in contrast, is significant, and must be equal to the estimated coefficient. How do you react?

- A4. You cannot simply conclude that $\beta = 0$. The low t-statistic says that, on the basis of only the sample information, it is *possible* that the true beta is zero. But you know more than a computer or calculator (which evaluate only the sample information). As an intelligent human being, you would not expect the true beta for a highly cyclical sector

(machine tools) to be zero, or even much below unity. Thus, the estimate 0.56 is probably better than the conjecture $\beta = 0$. An industry β would be more reliable.

The high t-statistic for the exposure (γ) means that one can reject, beyond what most statisticians would call a reasonable doubt, the hypothesis that the true exposure is zero. However, from a purely statistical point of view, the true exposure could still be 0.5, or 0.75, or 1—in fact, with $\sigma = 4.25/2.063 = 2.06$, anything in the range of $4.25 \pm (2 \times 2.063)$ is statistically acceptable. However, your common sense tells you that true exposures are unlikely to exceed unity. Thus, the estimated beta may be erring on the downward side, and the estimated γ almost surely errs on the upward side.

- E5. Suppose the world beta for a German stock (in DEM) equals 1.5, and its exposures to the dollar, the yen, and the pound are 0.3, 0.2, and 0.1, respectively.
- What is the best replicating portfolio if you can invest in a world-market index fund, as well as in dollars, yens, pounds, and marks?
 - What additional information is needed to identify the cost of capital?
- A5. (a) $x_w = 1.5$, $x_{USD} = 0.3$, $x_{JPY} = 0.2$, $x_{GBP} = 0.1$, and $x_{DEM} = 1 - 1.5 - 0.3 - 0.2 - 0.1 = -1.1$.
- (b) The expected excess returns on each of these assets (including, for the currencies, the risk-free rates).
- E6. Suppose that there are two countries, the US and Canada. The exposure of the company XUS, in terms of USD, is estimated as follows:

$$\tilde{r}_{XUS}^* = 0.12 + 0.30 \tilde{s}_{USD/CAD} + \varepsilon$$

What is the company's exposure in terms of CAD?

- A6. Over short periods, the percentage change in the CAD/USD rate is approximately equal to the negative of the change in the CAD/USD exchange rate. Thus, a 1 percent rise in the USD/CAD value means a -1 percent drop in the USD/CAD rate, and on average a -0.3 percent drop in the stock's USD price. Thus, the total effect on the CAD return from XUS of a 1 percent rise of the USD is $1 - 0.30 = 0.70$: $r_{XUS} = a + 0.7 \tilde{s}_{CAD/USD} + \varepsilon$

Mind-Expanding Exercises

- ME1. Critically discuss the following popular statements:
- "If an investor buys foreign stocks, he or she is also investing, in a sense, in the corresponding foreign currency."
 - "If a German investor buys oil futures, he or she is also investing in USD because oil prices are quoted in USD."
 - "If a German investor buys zinc or lead futures on FOX, London's (commodity) Futures and Options Exchange, the investor is also investing in GBP because the zinc or lead futures are quoted in GBP."
- A1. (a) Correct in the sense that there is likely to be a positive exposure to the foreign currency; however, the relative exposure need not be unity (as conventional wisdom often suggests).
- (b) This would be true if, as was the case in the second half of the seventies, oil prices were actually *fixed* (by OPEC) in terms of USD. Then a 10 percent appreciation of the USD meant a 10 percent increase in the DEM price of oil. Nowadays, oil prices are no longer fixed in USD, though. An 10 percent appreciation of the

USD combined with a constant USD oil price would lead to a drop in demand for oil outside the US, which would then exert a downward pressure on the USD price of oil. That is, a 10 percent appreciation of the USD is likely to be associated with a drop in the USD price, implying that, to a German investor, the dollar exposure of oil futures is likely to be below unity.

- (c) The GBP exposure of zinc futures is probably quite low. Since most of the lead and zinc consumption actually originates from outside the UK, an increase in the value of the pound would seriously affect demand from the rest of the world if the GBP price would stay constant. Thus, the GBP price of zinc would drop so as to undo (most of) the effect of the appreciation of the GBP, implying that, to a German investor, the GBP exposure of zinc futures is probably rather low.

- ME2. Suppose that there are just two countries. The CAD T-bill rate is 6 percent *p.a.*, and the USD rate 5 percent. In terms of CAD, the world market portfolio and the USD T-bill are expected to outperform the CAD T-bill rate by 8 percent and 1 percent *p.a.*, respectively. You run a regression on past data, which yields the following estimates:

$$\tilde{r}_{XUS} = 0.08 + 0.8 \tilde{r}_w + 0.25 \tilde{s}_{CAD/USD} + \varepsilon.$$

What is the expected return, in CAD, on XUS common stock (a) if you use the International CAPM, and (b) if you use the regression only? How do you explain the differences? Which is more trustworthy?

- A2. According to the International CAPM, $E(\tilde{r}_{XUS}) = 0.06 + (0.8 \times 0.08) + (0.25 \times 0.01) = 0.1265$. This is different from the expected value obtained from the regression output. The regression itself would predict a return equal to $0.08 + 0.8 \times [0.08 + 0.06] + 0.25 \times [0.01 - 0.05 + 0.06] = 0.197$.¹ In light of the CAPM, one possible diagnosis is that the estimated intercept, 0.08, is too high: during the sample period, the stock happened to realize an average return that was higher than expected. In that sense, the international CAPM is more trustworthy than the regression, since it avoids excessive reliance on the sample mean return from the stock. However, the beta or gamma is also likely to contain some measurement error, and your expected world market return and expected risk premium on the USD T-bill may be inexact. The message is that, even with the guidance from CAPM, the cost of capital remains an estimate subject to error and is worth some sensitivity analysis.

- ME3. Suppose that there are three countries: the US, Canada, and the European Union. So from the US point of view, there are two exchange rates, USD/CAD and USD/ECU. The exposure of company XUS, in terms of USD, is estimated as follows:

$$\tilde{r}_{XUS}^* = 0.03 + 0.20 \tilde{s}_{USD/CAD} + 0.15 \tilde{s}_{USD/ECU} + \varepsilon^*.$$

What is the exposure in terms of CAD? That is, what are $\gamma_{XUS,CAD/USD}$ and $\gamma_{XUS,CAD/ECU}$ in

$$\tilde{r}_{XUS} = \alpha + \gamma_{XUS,CAD/USD} \tilde{s}_{CAD/USD} + \gamma_{XUS,CAD/ECU} \tilde{s}_{CAD/USD} + \varepsilon?$$

Hint: substitute $\tilde{s}_{CAD/USD} \cong -\tilde{s}_{USD/CAD}$ and $\tilde{s}_{USD/ECU} \cong \tilde{s}_{CAD/ECU} - \tilde{s}_{CAD/USD}$ into the original exposure regression, and then use $\tilde{r}_{XUS}^* \cong \tilde{r}_{XUS} + \tilde{s}_{CAD/USD}$. It can be shown that these linear approximations induce very little error in the implied CAD exposures, although they are more off the mark with regard to the implied CAD intercept.²

¹ The terms within square brackets are the expected returns. $E(r_w) = [E(r_w) - r] + r = 0.08 + 0.06$; similarly, $E(\tilde{s}_{CAD/USD}) = [E(\tilde{s}_{CAD/USD}) + r_{USD} - r] - r_{USD} + r = 0.01 - 0.05 + 0.06 = 0.02$.

² See Sercu (1981, Appendix) for a more formal derivation of the link between the two exposure regressions.

- A3. Start from the exposure regression in terms of USD. First, rewrite the exchange rates in CAD terms:

$$\tilde{r}_{XUS} = 0.03 + 0.20 \tilde{s}_{USD/CAD} + 0.15 \tilde{s}_{USD/ECU} + \varepsilon$$

$$\cong 0.03 + 0.20 [-\tilde{s}_{CAD/USD}] + 0.15 [\tilde{s}_{CAD/ECU} - \tilde{s}_{CAD/USD}] + \varepsilon.$$

Then, add $\tilde{s}_{CAD/USD}$ on both sides to obtain the return in CAD:

$$\tilde{r}_{XUS}^* \cong \tilde{r}_{XUS} + \tilde{s}_{CAD/USD}$$

$$\cong 0.03 - 0.20 [\tilde{s}_{CAD/USD}] + 0.15 [\tilde{s}_{CAD/ECU} - \tilde{s}_{CAD/USD}] + \tilde{s}_{CAD/USD} + \varepsilon$$

$$= 0.03 + (1 - 0.20 - 0.15) \tilde{s}_{CAD/USD} + 0.15 \tilde{s}_{CAD/ECU} + \varepsilon$$

$$= 0.03 + 0.65 \tilde{s}_{CAD/USD} + 0.15 \tilde{s}_{CAD/ECU} + \varepsilon.$$

Thus, the new exposure to the old reference currency (0.65 for the USD) is equal to unity minus the sum of the old exposures (that is, $1 - 0.2 - 0.15$), while the exposure to third currency (the ECU) is not affected.