

Chapter 16 The Relevance of Hedging

Quiz Questions

True-False Questions

- _____ 1. In perfect markets, a manager's decision to hedge a firm's cash flows is irrelevant because there is no exchange rate risk.
- _____ 2. In perfect markets, a manager's decision to hedge a firm's cash flows is irrelevant because the shareholders can hedge exchange risk themselves.
- _____ 3. If a large firm keeps track of the exposure of each of its divisions, the firm has better information about each division, and is therefore better able to make decisions.
- _____ 4. If a firm does not have a hedging policy, the managers may insist on higher wages to compensate them for the risk they bear because part of their lifetime future wealth is exposed to exchange rate risk.
- _____ 5. If the firm does not have a hedging policy, the managers may refuse to undertake risky projects even when they have a positive net present.
- _____ 6. The risk-adjusted expected tax savings from borrowing in your local currency always equals the present value of the expected tax savings from borrowing in a foreign currency.
- _____ 7. The cost of hedging is roughly half of the difference between the forward premium and the spot exchange rate.
- _____ 8. A re-invoicing center assumes the exchange rate risk of the various subsidiaries of a multinational corporation if it allows each subsidiary to purchase or sell in its "home" currency.

Ans. 1. false; 2. true; 3. true; 4. true; 5. true; 6. false; 7. false; 8. true.

True-False Questions

Determine which statements below are valid reasons for the manager of a firm to hedge exchange rate risk and which are not.

- _____ 1. The manager should use hedging in order to minimize the volatility of the cash flows and therefore the probability of bankruptcy even though the expected return on the firm's stock will also be minimized.
- _____ 2. Firms may benefit from economies of scale when hedging in forward or money markets, while individual shareholders may not.
- _____ 3. When a firm's cash flows are highly variable, the chance of financial distress is greater, and financial distress is costly in imperfect markets.
- _____ 4. Shareholders do not have sufficient information about a firm's exposure.
- _____ 5. Risk averse employees demand a risk premium when the volatility of a firm's cash flows exceeds the level of the firm's debt.
- _____ 6. Short selling is often difficult or impossible for the individual shareholders.

- _____ 7. Hedging a foreign-currency inflow is beneficial when the forward rate is at a premium, because it is profitable and therefore desirable. In contrast, such hedging is not desirable when the forward rate is at a discount.
- _____ 8. Since a forward contract always has a zero value, it never affects the value of the firm, but it is desirable because it reduces the variability of the cash flows.
- _____ 9. Hedging reduces agency costs by reducing the variability of the firm's cash flows. Hedging means that the manager bears less personal income risk, making the manager more likely to accept risky projects with a positive net present value.
- _____ 10. Hedging is desirable for firms that operate in a flat tax-rate environment because income smoothing means that they can expect to pay less taxes.
- _____ 11. Managers have an incentive to hedge in order to reduce the variability of the firm's cash flows because even though a firm may be able to carry forward losses, there is a loss due to time value of the tax shield.

Ans. 1. false; 2. true; 3. true; 4. true; 5. false; 6. true; 7. false: the forward rate is the just risk-adjusted expected value of the future (unknown spot rate); 8. false: a forward contract has a zero value only at inception; it is true though that the contract reduces the variability of the cash flows; 9. true; 10. false; 11. true.

Multiple Choice Questions

Choose the correct answer(s):

- Q1. The Modigliani-Miller theorem as applied to the firm's hedging decision states that:
- (a) In perfect markets and for given operational cash flows, hedging is irrelevant because by making private transactions in the money and foreign exchange markets, the shareholders can eliminate the risk of the cash flows.
 - (b) Bankruptcy is not costly because capital markets are perfect.
 - (c) A firm's value cannot be increased by changing the proportion of debt to equity used to finance the firm. Thus, the value of the tax shield from borrowing in home currency exactly equals the risk-adjusted expected tax shield from borrowing in foreign currency.
 - (d) If the shareholders are equally able to reduce the risk from exchange rate exposure as the firm, then hedging will not add to the value of the firm.
 - (e) Markets are perfect, so hedging by the manager of the firm and the shareholders is irrelevant.

A1. (a), (d).

- Q2. Hedging may reduce agency costs because:
- (a) Some of the uncertainty about a manager's lifetime income has been diversified away.
 - (b) The shareholders will always prefer volatile projects while the debtholders will prefer non-volatile ones.
 - (c) Risk-averse employees will demand a risk premium from a firm that is more likely to be in financial distress.
 - (d) Customers will think twice about purchasing goods from a company that may not be able to offer long-term customer service.
 - (e) A reduction in the variability of the firm's cash flows may reduce the likelihood for conflicts between the debtholders and the shareholders.

- A2. (a), (e); (c) and (d) are true in themselves but are not related to the concept of agency costs.
- Q3. Which of the following statements represent capital market imperfections?
- (a) Agency costs.
 - (b) The difference between half of the bid-ask spread between the spot and forward markets.
 - (c) The potential costs from renegotiating a loan that has gone into default.
 - (d) The lost time value from having to carry forward losses into a successive tax year.
 - (e) Fees for liquidators, lawyers, and courts in the case of bankruptcy.
- A3. (b), (c), (e).

Exercises

- E1. Using the following data, compute the cost of hedging for each forward contract in terms of implicit commission and in terms of the extra spread as a percent of the midpoint spot rate.

maturity	rates	bid-ask spread	cost of hedging	extra spread as a % of midpoint spot rate
spot	49.858 - 49.898	0.04		
fwd 30 days	49.909 - 49.965	0.056		
fwd 60 days	49.972 - 50.043	0.071		
fwd 90 days	50.061 - 50.157	0.096		
fwd 180 days	50.156 - 50.292	0.136		

A2.

maturity	rates	bid-ask spread	cost of hedging	extra spread as a % of midpoint spot rate
spot	49.858 - 49.898	0.04	-	-
fwd 30 days	49.909 - 49.965	0.056	0.016	0.016%
fwd 60 days	49.972 - 50.043	0.071	0.031	0.031%
fwd 90 days	50.061 - 50.157	0.096	0.056	0.056%
fwd 180 days	50.156 - 50.292	0.136	0.096	0.096%

- E2. In the wake of the Northern American Free Trade Agreement, the firm All-American Exports, Inc. has begun exporting baseball caps and gloves to Mexico. Suppose that All-American is subject to a tax of 30 percent when it earns profits less than or equal to USD 10 million and 40 percent on the part of the profits that exceeds USD 10 million. The table below shows the company's profits in USD under three exchange rate scenarios and when the firm has hedged its income and when it has left its income unhedged. The probability of each level of the exchange rate is also given.

	Profits		Probability
	Hedged	Unhedged	
S_{high}	15m	20m	25%
$S_{\text{unchanged}}$	10m	10m	50%
S_{low}	5m	0	25%

- Compute the taxes that All-American must pay under each scenario.
- What are All-American's expected taxes when it hedges its income?
- What are All-American's expected taxes when it does not hedge its income?

A2. (a)

	Taxes		Probability
	Hedged	Unhedged	
S_{high}	6m	8m	25%
$S_{\text{unchanged}}$	3m	3m	50%
S_{low}	1.5m	0	25%

- Expected taxes given hedging = 3.375.
- Expected taxes without hedging = 3.5.

- E3. In order to hedge its Mexican peso earnings, All-American is considering borrowing MEP 25 million, but is concerned about losing its USD interest tax shield. The exchange rate is USD/MEP 0.4, $r_{t,T} = 8$ percent, and $r_{t,T}^* = 6$ percent. The tax rate is 35 percent.

- What is All-American's tax shield from borrowing in USD?
- What is All-American's tax shield from borrowing in MEP?
- What is the risk-adjusted expected tax shield from borrowing in MEP?

- A3. (a) $\text{USD } 10\text{m} \times 0.08 = \text{USD } 0.8\text{m}$: tax savings $\text{USD } 0.8 \times 0.35 = \text{USD } 280,000$.
(b) $\text{MEP } 25\text{m} \times 0.06 = \text{MEP } 1.5\text{m}$: tax savings $\text{MEP } 1.5 \times 0.35 = \text{MEP } 525,000$.
(c) $F_{t,T} = 0.4 \times \frac{1.08}{1.06} = 0.40755$. The tax shield from interest is worth $\text{MEP } 525,000 \times 0.40755 = \text{USD } 213,964$ in terms of risk-adjusted expectations. In addition, there is an expected appreciation of $\text{MEP } 25\text{m} \times (0.40755 - 0.4) = \text{USD } 188,750$, which carries a tax savings of $\text{USD } 66,063$. Thus, the total tax savings, after risk-adjustment, are expected to be $\text{USD } 213,964 + 66,063 = \text{USD } 280,027$.

Chapter 17 Measuring and Managing Contractual Exposure to the Exchange Rate

Quiz Questions

True-False Questions

- _____ 1. Exchange risk describes how volatile a firm's cash flows are with respect to any one exchange rate.
- _____ 2. Exchange exposure is a measure of the sensitivity of a firm's cash flows to a change in the spot exchange rate.
- _____ 3. Hedging exposure means eliminating all risk from a net position in a foreign currency.
- _____ 4. From the regression equation in Section 17.1.1, if your exposure is USD -3 million, the value of the firm's cash flows will decrease by USD 3 million for every unit decrease in the future spot exchange rate.
- _____ 5. Contractual exposure is the absolute change in the firm's cash flows for a unit change in the spot exchange rate.
- _____ 6. Operating exposure is the exposure that results when the forward rate is at discount with respect to the spot rate at the moment you sign a sales or purchase contract.
- _____ 7. Contractual exposure is additive for one maturity and one currency.
- _____ 8. Options are undoubtedly the best choice for hedging foreign currency exposure because the possibility of profiting from a favorable change in the exchange rate remains open without the losses from an unfavorable change in the exchange rate.
- _____ 9. Reverse exchange risk is the risk that arises when you receive a foreign currency A/R that you left unhedged, and the exchange rate at the time of receipt is unexpectedly low.
- _____ 10. When interest rates are zero, we can the aggregate exposures of a given currency across time.
- _____ 11. If interest rates are positive but certain, we aggregate the exposure of one currency across time once we take time value into account.
- _____ 12. By pooling the aggregate exposure of one currency across time, we can ignore time value, because we have arbitrated away interest rate risk. The only risk that remains is exchange rate risk.
- _____ 13. Duration is the average life of a loan.
- _____ 14. If you need to hedge a series of exposures with different maturities, it is best to hedge the negative exposures separately from the positive exposures.

Ans. 1. false; 2. true; 3. true: unless the term "hedging" also refers to partial hedging; 4. false; 5. false; 6. false; 7. true; 8. false: you pay a fair price for such an option, so it is not obvious that an option is superior to a linear hedge; 9. false; 10. true; 11. true; 12. false; 13. false; 14. true.

Matching Questions

Suppose that you are a manager at a British firm, and you are responsible for managing exchange rate exposure. Determine whether the following statements are related to accounting exposure (AE), operating exposure (OE), or contractual exposure (CE).

- _____ 1. Your German subsidiary has recently purchased machinery in Germany.
- _____ 2. You bought a call option on ESP to hedge and ESP accounts payable.

- _____ 3. You have just sold goods to an American customer. The customer has 90 days to pay in USD.
- _____ 4. You have just developed an exciting new product. The success of this product depends on how it is priced in the local currencies of your export markets.
- _____ 5. You have made a bid to deliver your exciting new product to schools in France during the next academic year. You will learn whether or not the bid has been accepted in three months.
- _____ 6. You sell wool but face potential competition from Australia. If there are no imports, the price of your wool will be GBP 1. However, Australians enter your market once the exchange rate falls below GBP/AUD 2.

Ans. 1. AE because the machinery is an asset whose value has to be translated for the company's consolidated balance sheet. There could also be transaction exposure if the machinery is still to be paid for and the price is expressed in a third currency. Also, OE since the market value of the investment will depend on exchange rates; 2. CE, initially and afterwards (because the option is not a perfect hedge); 3. CE. Also, AE if the reporting date is within 90 days; 4. OE; 5. OE; 6. OE.

Exercises

- E1. The Dutch firm, Benelux Business Concepts (BBC), has a BEF A/P totaling BEF 100,000 and a LUF A/R totaling LUF 200,000. The BEF/LUF exchange rate is fixed at 1.
- Can BBC offset its BEF A/P with its LUF A/R?
 - If so, how much exposure remains?
- A1. (a) Yes, because the BEF/LUF exchange rate is fixed, and the NLG/BEF and NLG/LUF spot exchange rates are perfectly correlated. Therefore, the A/R and A/P are perfectly hedged up to BEF 100,000 or LUF 100,000.
- (b) An exposure of LUF 100,000 still remains.
- E2. The Dutch manufacturer Cloghopper has the following JPY commitments:
- A/R of JPY 1,000,000 for thirty days.
 - A/R of JPY 500,000 for ninety days.
 - Sales contract (twelve months) of JPY 30,000,000.
 - A forward sales contract of JPY 500,000 for ninety days.
 - A deposit which at maturity in three months pays JPY 500,000.
 - A loan for which you will owe JPY 8,000,000 in six months.
 - A/P of JPY 1,000,000 for thirty days.
 - A forward sales contract for JPY 10,000,000 for twelve months.
 - A/P of JPY 3,000,000 for six months.
- What is Cloghopper's net exposure for each maturity?
 - How would Cloghopper hedge the exposure for each maturity on the forward market?
 - Assume that the interest rate is 5 percent (compound, *per annum*) for all maturities and that this rate will remain 5 percent with certainty for the next twelve months. Also, ignore bid-ask spreads in the money market. How would the company hedge its exposure on the spot market and the JPY money market? Describe all money market transactions in detail.
 - If the interest rate is 5 percent (compound, *per annum*) for all maturities and will remain 5 percent with certainty for the next twelve months, how would the

company hedge its exposure on the forward market if only one forward contract is used? Describe all money market transactions in detail.

- (e) Assume that Cloghopper prefers to use traded options rather than forward contracts. The option contracts are not divisible, and for each maturity the face value of a contract is JPY 1,000,000. How could Cloghopper hedge its exposure? Do the options offer a perfect hedge for each maturity?
- (f) Drop the assumption of a flat and constant term structure. If Cloghopper wants to hedge its exchange rate exposure using one forward contract and its interest rate exposure using FRA contracts, how would the analysis of parts (c) and (d) be affected? A verbal discussion suffices.
- (g) The term structure is flat right now (at 5 percent *p.a.*, compound), but is uncertain in the future. Consider the spot hedge of part (c). If, instead of FRAs, duration is used to eliminate the interest risk, how should Cloghopper proceed?

A2. (a)

Maturity	30 days	90 days	180 days	360 days
1)	1,000,000			
2)		500,000		
3)				30,000,000
4)		-500,000		
5)	500,000			
6)			-8,000,000	
7)	-1,000,000			
8)				-10,000,000
9)			-3,000,000	
Total	500,000	0	-11,000,000	20,000,000

- (b) For 30 days, sell JPY 500,000 forward.
For 90 days, no hedging necessary.
For 180 days, buy JPY 11,000,000 forward.
For 360 days, sell JPY 20,000,000 forward.
- (c) The total time-*t* value of Cloghopper's exposure equals

$$\frac{500,000}{(1.05)^{1/12}} - \frac{11,000,000}{(1.05)^{6/12}} + \frac{20,000,000}{1.05} = \text{JPY } 8,810,690.$$

Thus, Cloghopper can sell the time-*t* value of its exposure on the spot market. That is, it borrows JPY 8,810,690 and converts this amount into NLG. After 30 days, the company makes a partial repayment of JPY 500,000 on its JPY loan; after 180 days it borrows another JPY 11m (at 5 percent compound, for five months); and after 360 days it pays off all its debts, including interest, with the JPY 20m inflow. Thus, no spot transaction is needed at all after the initial hedge—that is, the exposure is eliminated.

- (d) Cloghopper could hedge its exposure with one forward contract in many different ways, depending on the maturity of the forward contract it chooses. Following are the computations for 30, 180, and 360 days:

- 1) *Hedge with a 30-days forward contract.* Cloghopper first discounts its 180 and 360 days exposure to 30 days:

$$\text{JPY } 500,000 - \frac{11,000,000}{(1.05)^{5/12}} + \frac{20,000,000}{(1.05)^{11/12}} = \text{JPY } 8,846,585.$$

Cloghopper then sells this exposure forward at the forward rate for 30 days. After 30 days Cloghopper borrows JPY 8,346,585 and delivers these, together with the JPY 500,000, to its bank which delivers home currency in return. After 180 days, it borrows another JPY 11m (at 5 percent compound, for five months). After 360 days, it receives an inflow of JPY 20m which is exactly enough to pay off the first debt plus interest at JPY 8,728,354 and the second debt plus interest at JPY 11,271,646.

- 2) *Hedge with a 180-days forward contract.* Cloghopper first computes the future value of its 30 day exposure at 180 days and the discounted value of its 360 day exposure at 180 days:

$$\text{JPY } 500,000 \times (1.05)^{5/12} - 11,000,000 + \frac{20,000,000}{(1.05)^{6/12}} = \text{JPY } 9,028,270.$$

Cloghopper then sells this exposure forward at the forward rate for 180 days. After 30 days, the company invests its JPY 500,000 inflow for five months. After 180 days, the proceeds of this investment are delivered to the bank; the company also borrows another JPY $9,028,270 - 500,000 \times (1.05)^{5/12} = 8,300,421$ to fulfill its remaining forward obligations. In addition, it borrows JPY 11m to pay its A/P. After 360 days, all outstanding loans, including interest, are paid back using the JPY 20m from the A/R.

- 3) *Hedge with a 360-days forward contract.* Cloghopper first computes the future value of its 30- and 180- day exposures at 360 days:

$$\text{JPY } 500,000 \times (1.05)^{11/12} - 11,000,000 \times (1.05)^{6/12} + 20,000,000 = \text{JPY } 9,251,224.$$

Cloghopper sells its exposure of JPY 9,251,224 forward at the forward rate for 360 days. After 30 days, it invests its JPY 500,000 inflow at 5 percent *p.a.* for eleven months; after 180 days, it borrows JPY 11m to settle its A/P. After 360 days, its net debt (including interest) and its forward obligation are all settled using the JPY 20m inflow.

- (e) Because the option contract is not divisible, Cloghopper's 30-day exposure of JPY 500,000 may remain unhedged. The alternative is to buy one contract, which leaves the company with a "speculative" JPY 500,000 long call. It can hedge its 180-day exposure by buying eleven call contracts or selling eleven put contracts and its 360-day exposure by buying twenty put contracts or selling twenty call contracts. Cloghopper's 180- and 360-day exposures will be fully hedged.
- (f) For all discounting to the current time (in part (c)), the appropriate spot interest rate for the maturity has to be used—ask for deposits, bid for loans. For all future value computations, Cloghopper should use the appropriate forward rates—for example 30 to 180 days, bid, in (d.1). Similarly, forward rates are to be used for all discounting to a future point in time—for example, 30 to 360 days, ask, in (d.1).
- (g) As Cloghopper has both positive and negative exposures, these should be hedged separately. Cloghopper could deposit the present value of its negative exposure for 180 days, that is,

$$\text{JPY } \frac{11\text{m}}{(1.05)^{6/12}} = 10,734,901.$$

This deposit perfectly matches this single outflow, so no interest risk remains on the short side.

Cloghopper also computes the present value and the duration of its positive exposures:

$$PV = \frac{0.5\text{m}}{(1.05)^{1/12}} + \frac{20\text{m}}{1.05} = \text{JPY } 19,545,590$$

$$\text{Duration} = \frac{(1/12) \times \frac{0.5\text{m}}{(1.05)^{1/12}} + 1 \times \frac{20\text{m}}{1.05}}{19,545,590} = 0.977 \text{ years, or 356 days.}$$

Cloghopper should then take out a loan in JPY with, initially, the above PV and time to maturity. Once or twice a month—or more often, if interest rates change drastically—it should reassess the present value and duration, and adjust its loan.

Mind-Expanding Exercise

- ME1. Masiello Manufacturing, an Italian clothing manufacturer, has a ten-year sales contract for the delivery of men's suits to the American retailer Moxies. Sales will equal USD 5 million each year. The interest rate in the US is 10 percent (assume that the interest rate curve is flat).
- How can Masiello hedge its exposure using a single (zero-coupon) USD loan?
 - The alternative is to take out ten separate zero-coupon USD loans, each having a final value of USD 5m. However, zero-coupon loans with long lives are unusual, and Masiello's bank accordingly proposes a single loan, with regular interest payments. How should the amortization schedule of the loan be set so as to avoid the periodic rebalancing caused by duration?
 - Compare the single loan of part (b) to the portfolio of ten separate zero-coupon loans, in terms of payments to the lender(s), and in terms of tax shields.
- A1.
 - The present value of the total sales contract equals USD 30.722 million, and the duration equals 4.73 years. Masiello can borrow this amount in the US by issuing debt with a future value equal to USD 48.221, a present value equal to USD 30.722 and a duration equal to 4.73.
 - Masiello should obtain a loan with service payments (gradual amortization plus periodic interest) of USD 5m for ten years—that is, a constant annuity loan or sinking-fund loan. The PV is USD 30.722 million. You can patiently unscramble the amortization and interest components implicit in the annuities, as follows:

	1	2	3	4	5	6	7	8	9	10
Balance—begin of year	30.73	28.80	26.68	24.34	21.78	18.96	15.85	12.44	8.68	4.55
Interest at 10 percent	3.07	2.88	2.67	2.43	2.18	1.90	1.59	1.24	0.87	0.46
Payment towards principal	1.93	2.12	2.33	2.57	2.82	3.10	3.41	3.76	4.13	4.54
Interest plus principal	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00

- In terms of payments to the lenders, this sinking-fund loan is identical to a portfolio of ten separate zero-coupon loans. In accounting and fiscal terms, the interest tax shield will be the same if, for each reporting year, accrued interest on the zero-coupon bonds is computed using compound interest. In contrast, if the original discount on the zero-coupon bonds is allocated to the profit and loss accounts of the ten reporting years using a linear pro-rata rule, the present value of the tax shields will be higher than in the case of a single annuity loan.