

## **CHAPTER 3**

### **Hedging Strategies Using Futures**

#### **Short Concept Questions**

**3.1** A short hedge is appropriate when a company owns an asset and expects to sell that asset in the future. It can also be used when the company does not currently own the asset but expects to do so at some time in the future. A long hedge is appropriate when a company knows it will have to purchase an asset in the future. It can also be used to offset the risk from an existing short position.

**3.2** (a) If the company's competitors are not hedging, the treasurer might feel that the company will experience less risk if it does not hedge. (See Table 3.1) (b) The shareholders might not want the company to hedge because the risks are hedged within their portfolios. (c) If there is a loss on the hedge and a gain from the company's exposure to the underlying asset, the treasurer might feel that he or she will have difficulty justifying the hedging to other executives within the organization.

**3.3** Basis risk arises from the hedger's uncertainty as to the difference between the spot price and futures price at the expiration of the hedge.

**3.4** Equation (3.1) for  $h^*$

**3.5** Equation before (3.3) for  $\hat{h}$

**3.6** See equations (3.2) and (3.3).

**3.7** To increase beta, a long position in index futures is required. To reduce beta, a short position in index futures is required. The size of the position is the difference in betas multiplied by the ratio of the value of the position to the value of the assets underlying one futures contract.

**3.8** They can hedge exposure to market moves using index futures. They will make money if the stocks they have picked outperform the market.

**3.9** Stack and roll involves creating a long-dated futures contract from a series of short-dated contracts.

**3.10** The short term futures in stack and roll might lead to losses which have to be financed until gains are made on the longer term risks being hedged.

## Practice Questions

### 3.11

A perfect hedge is one that completely eliminates the hedger's risk. A perfect hedge does not always lead to a better outcome than an imperfect hedge. It just leads to a more certain outcome. Consider a company that hedges its exposure to the price of an asset. Suppose the asset's price movements prove to be favorable to the company. A perfect hedge totally neutralizes the company's gain from these favorable price movements. An imperfect hedge, which only partially neutralizes the gains, might well give a better outcome.

### 3.12

A minimum variance hedge leads to no hedging when the coefficient of correlation between the futures price changes and changes in the price of the asset being hedged is zero.

### 3.13

The optimal hedge ratio is

$$0.8 \times \frac{0.65}{0.81} = 0.642$$

This means that the size of the futures position should be 64.2% of the size of the company's exposure in a three-month hedge.

### 3.14

The formula for the number of contracts that should be shorted gives

$$1.2 \times \frac{20,000,000}{1,080 \times 250} = 88.9$$

Rounding to the nearest whole number, 89 contracts should be shorted. To reduce the beta to 0.6, half of this position, or a short position in 44 contracts, is required.

### 3.15

A good rule of thumb is to choose a futures contract that has a delivery month as close as possible to, but later than, the month containing the expiration of the hedge. The contracts that should be used are therefore,

- (a) July
- (b) September
- (c) March

### 3.16

No. Consider, for example, the use of a forward contract to hedge a known cash inflow in a foreign currency. The forward contract locks in the forward exchange rate—which is in general different from the spot exchange rate.

### 3.17

The basis is the amount by which the spot price exceeds the futures price. A short hedger is long the asset and short futures contracts. The value of his or her position therefore improves as the basis increases. Similarly, it worsens as the basis decreases.

### 3.18

The simple answer to this question is that the treasurer should:

1. Estimate the company's future cash flows in Japanese yen and U.S. dollars.
2. Enter into forward and futures contracts to lock in the exchange rate for the U.S. dollar cash flows.

However, this is not the whole story. As the gold jewelry example in Table 3.1 shows, the company should examine whether the magnitudes of the foreign cash flows depend on the exchange rate. For example, will the company be able to raise the price of its product in U.S. dollars if the yen appreciates? If the company can do so, its foreign exchange exposure may be quite low. The key estimates required are those showing the overall effect on the company's profitability of changes in the exchange rate at various times in the future. Once these estimates have been produced, the company can choose between using futures and options to hedge its risk. The results of the analysis should be presented carefully to other executives. It should be explained that a hedge does not ensure that profits will be higher. It means that profit will be more certain. When futures/forwards are used, both the downside and upside are eliminated. With options, a premium is paid to eliminate only the downside.

### 3.19

If the hedge ratio is 0.8, the company takes a long position in 16 December oil futures contracts on June 8 when the futures price is \$48.00. It closes out its position on November 10. The spot price and futures price at this time are \$50.00 and \$49.10. The gain on the futures position is

$$(49.10 - 48.00) \times 16,000 = 17,600$$

The effective cost of the oil is therefore

$$20,000 \times 50 - 17,600 = 982,400$$

or \$49.12 per barrel. (This compares with \$48.90 per barrel when the company is fully hedged.)

### 3.20

The statement is not true. The minimum variance hedge ratio is

$$\rho \frac{\sigma_S}{\sigma_F}$$

It is 1.0 when  $\rho = 0.5$  and  $\sigma_S = 2\sigma_F$ . Since  $\rho < 1.0$  the hedge is clearly not perfect.

### 3.21

The statement is true. Suppose for the sake of definiteness that the commodity is being purchased. If the hedge ratio is  $h$ , the gain on futures is  $h(F_2 - F_1)$  so that the price paid is  $S_2 - h(F_2 - F_1)$  or  $hb_2 + hF_1 + (1-h)S_2$ . If there is no basis risk,  $b_2$  is known. For a given  $h$ , there is therefore no uncertainty in the first two terms. For any value of  $h$  other than 1, there is uncertainty in the third term. The minimum

variance hedge ratio is therefore 1.

### 3.22

A company that knows it will purchase a commodity in the future is able to lock in a price close to the futures price. This is likely to be particularly attractive when the futures price is less than the spot price.

### 3.23

The optimal hedge ratio is

$$0.7 \times \frac{1.2}{1.4} = 0.6$$

The beef producer requires a long position in  $200,000 \times 0.6 = 120,000$  lbs of cattle. The beef producer should therefore take a long position in 3 December contracts closing out the position on November 15.

### 3.24

If weather creates a significant uncertainty about the volume of corn that will be harvested, the farmer should not enter into short forward contracts to hedge the price risk on the expected production. The reason is as follows. Suppose that the weather is bad and the farmer's production is lower than expected. Other farmers are likely to have been affected similarly. Corn production overall will be low and as a consequence the price of corn will be relatively high. The farmer's problems arising from the bad harvest will be made worse by losses on the short futures position. This problem emphasizes the importance of looking at the big picture when hedging. The farmer is correct to question whether hedging price risk while ignoring other risks is a good strategy.

### 3.25

A short position in

$$1.3 \times \frac{50,000 \times 30}{50 \times 1,500} = 26$$

contracts is required. It will be profitable if the stock outperforms the market in the sense that its return is greater than that predicted by the capital asset pricing model.

### 3.26

If the company uses a hedge ratio of 1.5 in Table 3.5, it would at each stage short 150 contracts. The gain from the futures contracts would be

$$1.50 \times 1.70 = \$2.55$$

per barrel and the company would be \$0.85 per barrel better off than with a hedge ratio of 1.

### 3.27

It may well be true that there is just as much chance that the price of oil in the future will be above the futures price as it will be below the futures price. This means that the use of a futures contract for speculation would be like betting on whether a coin comes up heads or tails. But it

might make sense for the airline to use futures for hedging rather than speculation. The futures contract then has the effect of reducing risks. It can be argued that an airline should not expose its shareholders to risks associated with the future price of oil when there are contracts available to hedge the risks.

### 3.28

Goldman Sachs can borrow 1 ounce of gold and sell it for \$1200. It invests the \$1,200 at 5% so that it becomes \$1,260 at the end of the year. It must pay the lease rate of 1.5% on \$1,200. This is \$18 and leaves it with \$1,242. It follows that if it agrees to buy the gold for less than \$1,242 in one year it will make a profit.

### 3.29

- a)  $0.05 + 0.2 \times (0.12 - 0.05) = 0.064$  or 6.4%
- b)  $0.05 + 0.5 \times (0.12 - 0.05) = 0.085$  or 8.5%
- c)  $0.05 + 1.4 \times (0.12 - 0.05) = 0.148$  or 14.8%

### 3.30

It should short five contracts. It has basis risk. It is exposed to the difference between the October futures price and the spot price of light sweet crude at the time it closes out its position in September. It is also possibly exposed to the difference between the spot price of light sweet crude and the spot price of the type of oil it is selling.

### 3.31

The excess of the spot over the futures at the time the hedge is closed out is \$0.20 per ounce. If the trader is hedging the purchase of silver, the price paid is the futures price plus the basis. The trader therefore loses  $60 \times 5,000 \times \$0.20 = \$60,000$ . If the trader is hedging the sales of silver, the price received is the futures price plus the basis. The trader therefore gains \$60,000.

### 3.32

- (a) The minimum variance hedge ratio,  $h^*$ , is  $0.95 \times 0.43 / 0.40 = 1.02125$ .
- (b) The hedger should take a short position.
- (c) The optimal number of contracts ignoring daily settlement is  $1.02125 \times 55,000 / 5,000 = 11.23$  (or 11 when rounded to the nearest whole number)
- (d) The optimal number of contracts is  $\hat{\rho} \hat{\sigma}_S V_A / (\hat{\sigma}_F V_F)$  where  $\hat{\rho}$  is correlation between percentage one-day returns of spot and futures,  $\hat{\sigma}_S$  and  $\hat{\sigma}_F$  are the standard deviations of percentage one-day returns on spot and futures,  $V_A$  is the value of the position and  $V_F$  is the futures price times the size of one contract. In this case,  $V_A = 55,000 \times 28 = 1,540,000$  and  $V_F = 5,000 \times 27 = 135,000$ . If we assume that  $\hat{\rho} = 0.95$  and  $\hat{\sigma}_S / \hat{\sigma}_F = 0.43 / 0.40 = 1.075$ , the optimal number of contracts when daily settlement is considered  $0.95 \times 1.075 \times 1,540,000 / 135,000 = 11.65$  (or 12 when rounded to the nearest whole number). This does not make the interest rate adjustment discussed in the final part of Section 3.4.

### 3.33

Equation (3.1) shows that the hedge ratio should be  $0.6 \times 1.5 = 0.9$ . Define  $Q$  as the number of gallons of the new fuel that the company is exposed to.  $0.001Q = 1,000,000$  so that  $Q$  is 100 million. It should therefore take a position of 90 million gallons in gasoline futures. Each futures contract is on 42,000 gallons. The number of contracts required is therefore

$$\frac{90,000,000}{42,000} = 2142.9$$

or, rounding to the nearest whole number, 2143.

### 3.34

When the expected return on the market is  $-30\%$ , the expected return on a portfolio with a beta of 0.2 is

$$0.05 + 0.2 \times (-0.30 - 0.05) = -0.02$$

or  $-2\%$ . The actual return of  $-10\%$  is worse than the expected return. The portfolio manager has done 8% worse than a simple strategy of forming a portfolio that is 20% invested in an equity index and 80% invested in risk-free investments. (The manager has achieved an alpha of  $-8\%$ !)

### 3.35

- a) The company should short

$$\frac{(1.2 - 0.5) \times 100,000,000}{2,000 \times 250}$$

or 140 contracts.

- b) The company should take a long position in

$$\frac{(1.5 - 1.2) \times 100,000,000}{2,000 \times 250}$$

or 60 contracts.