GENERAL PRINCIPLES OF HEDGING
WITH FUTURES

In this appendix, we explain the general principles of hedging with futures contracts. This explanation introduces numerous key concepts that underlie the applications and examples presented in this chapter.

The major function of futures markets is to transfer price risk from hedgers to speculators. That is, risk is transferred from those willing to pay to avoid risk to those wanting to assume the risk in the hope of gain. Hedging in this case is the employment of a futures transaction as a temporary substitute for a transaction in the cash market. The hedge position locks in a value for the cash position. As long as cash and futures prices move together, any loss realized on one position (whether cash or futures) will be offset by a profit on the other position. When the profit and loss are equal, the hedge is called a perfect (or textbook) hedge. In a market where the futures contract is correctly priced, a perfect hedge is risk free and, therefore, should provide a return equal to the risk-free rate.

Risks Associated with Hedging

In practice, hedging is not simple. The amount of the loss or profit on a hedge will depend on the relationship between the cash price and the futures price at two points in time, when a hedge is placed and when it is lifted. The difference between the cash price and the futures price is called the basis. That is,

\[ \text{Basis} = \text{Cash price} - \text{Futures price} \]

As we explained in the previous chapter, if a futures contract is priced according to its theoretical value, the difference between the cash price and the futures price should be equal to the cost of carry. The risk that the hedger takes on is that the basis will change for some reason. This possibility of change is called basis risk. Therefore, hedging involves the substitution of basis risk for price risk; that is, the substitution of the risk that the basis will change for the risk that the cash price will change.

When a futures contract is used to hedge a position where either the portfolio or the individual financial instrument is not identical to the instrument underlying the futures, it is called cross hedging. Cross hedging is common in asset/liability and portfolio management and in hedging a corporate bond issuance. The reason it is so common is that there are no futures contracts on specific common stock shares and bonds. Cross hedging introduces another risk—the risk that the price movement of the underlying instrument of the futures contract may not accurately track the price movement of the portfolio or financial instrument to be hedged. This is called cross-hedging risk. Therefore, the effectiveness of a cross hedge will be determined by two factors:

1. The relationship between the cash price of the underlying instrument and its futures price at the time when a hedge is placed and the time when it is lifted.
2. The relationship between the market (cash) value of the portfolio and the cash price of the instrument underlying the futures contract when the hedge is placed and when it is lifted.

Short and Long Hedges

A short hedge is used to protect against a decline in the cash price of a financial instrument or portfolio. To execute a short hedge, the hedger sells a futures contract (enters into the short side of a futures contract or agrees to make delivery). Consequently, a short hedge is also known as a sell hedge. By establishing a short hedge, the hedger has fixed the future cash price and transferred the price risk of ownership to the buyer of the futures contract.

A long hedge is undertaken to protect against an increase in the price of a financial instrument or portfolio to be purchased in the cash market at some future time. In a long hedge, the hedger buys a futures contract (enters into the long side of a futures contract or agrees to accept delivery). A long hedge is also known as a buy hedge.
Hedging Illustrations

We illustrate the principles of hedging and cross hedging using an agricultural commodity, corn, rather than a financial instrument or portfolio, because a corn futures contract is not as complicated as a stock index futures contract or an interest rate futures contract. The principles we illustrate are equally applicable to these futures contracts but easier to grasp with a farm product example not involving financial contract nuances.

Suppose that a corn farmer expects to sell 30,000 bushels of corn three months from now. Assume further that the management of a food processing company plans to purchase 30,000 bushels of corn three months from now. Both the corn farmer and the management of the food processing company want to lock in a price today. That is, each wants to eliminate the price risk associated with corn three months from now. The cash or spot price for corn is currently $2.75 per bushel.

A corn futures contract is available with the following terms: (1) The settlement date for the contract is five months from now, and (2) 5,000 bushels of corn must be delivered per contract. Notice that the settlement date is two months after the parties expect to lift their hedge. The futures price for this futures contract is currently $3.20 per bushel.

As the corn farmer seeks to lock in the price of corn to eliminate the risk of a decline in the price three months from now, he will place a short or sell hedge. That is, he will promise to make delivery of corn at the current futures price. The corn farmer will sell six futures contracts because each contract calls for the delivery of 5,000 bushels of corn. Three months from now, the corn farmer will do two things: deliver his corn at the prevailing price in the cash market and lift his short futures hedge by buying the corn futures contract, which will then have two months to settlement. The price at which the corn farmer will buy the corn futures contract depends on the futures contract price three months from now.

The management of the food processing company seeks to lock in the cost of corn to eliminate the risk of an increase in the price of corn three months from now. Consequently, management will place a buy or long hedge. That is, it will agree to accept delivery of corn at the futures price. Protection is sought against a price increase for 30,000 bushels of corn, so six contracts are bought. Three months from now, the food processing company will have to purchase corn in the cash market, paying the prevailing market price. To offset the long corn futures position, which has two months remaining until settlement, the food processing company will sell the contract at the then-prevailing futures price.

Let’s look at what happens under various scenarios for the cash price and the futures price of corn three months from now when both parties lift their hedges by reversing their futures contract positions.

Suppose that, when the hedges are lifted, the cash price declines to $2.00 and the futures contract price declines to $2.45. Notice what happens to the basis under this scenario. At the time the hedge is placed, the basis is $0.45 ($2.75 − $3.20). When the hedge is lifted, the basis is still $0.45 ($2.00 − $2.45).

The corn farmer, when he placed the hedge, wanted to lock in a price of $2.75 per bushel of corn, or $82,500 for 30,000 bushels. He sold six futures contracts at a price of $3.20 per bushel, or $96,000 for 30,000 bushels. When he lifts his short hedge, the value of the farmer’s corn is $60,000 ($2.00 × 30,000). The corn farmer realizes a decline in the cash market value of his corn of $22,500, but the futures price has declined to $2.45, so the cost to the corn farmer to liquidate his futures position is only $73,500 ($2.45 × 30,000). The corn farmer realizes a gain in the futures market of $22,500, or $96,000 − $73,500. The net result is that the gain in the futures market matches the loss in the cash market. Consequently, the corn farmer, by hedging, succeeds in ensuring a price per unit of $2.75, precisely equal to the initial price he had intended to realize for himself. This is an example of a perfect or textbook hedge.

Because there was a decline in the cash price, the food processing company would realize a gain in the cash market of $22,500 but would realize a loss in the futures market of the same amount. Therefore, this buy or long hedge is also a perfect or textbook hedge from the perspective of the food processing company, ensuring a cost per unit equal to the initial price of $2.75.

This scenario illustrates two important points. First, for both participants there was no overall gain or loss. The reason for this result is our assumption that the basis did not change while the hedges were in place.
Thus, if the basis does not change, a perfect hedge will be achieved. Second, note that the management of the food processing company would have been better off if it had not hedged. The cost of corn would have fallen $22,500 in the cash market over the three months. This failure to gain from the decline in the cash price should not be interpreted as a sign of poor planning by management. Management is not in the business of speculating on the future price of corn. Hedging is a standard practice to ensure the price to be paid at the delivery date, thus eliminating future price uncertainty.

Suppose that the cash price of corn, when the hedge is lifted, increases to $3.55, and that the futures price increases to $4.00. Notice that the basis is unchanged at $0.45. As long as the basis is unchanged, the cash and futures price we have assumed in this scenario will produce a perfect hedge.

The corn farmer will gain in the cash market because the value of 30,000 bushels of corn is $106,500 ($3.55 \times 30,000). This represents a $24,000 gain, compared to the cash value at the time the hedge was placed. However, the corn farmer must liquidate his position in the futures market by buying six futures contracts at a total cost of $120,000, which is $24,000 more than when the contracts were sold. The loss in the futures market offsets the gain in the cash market, which is the meaning of a perfect hedge. The food processing company would realize a gain in the futures market of $24,000 but would have to pay $24,000 more in the cash market to acquire 30,000 bushels of corn.

Note that the management of the food processing company under this scenario saved $24,000 in the cost of corn by employing a hedge. The corn farmer, though, would have been better off if he had not used a hedging strategy but rather simply sold his product on the market three months later. Again, it must be emphasized that the corn farmer, just like the management of the food processing company, employed a hedge to protect against unforeseen and adverse price changes in the cash market.

These scenarios assume that the basis does not change when the hedge is lifted. In the real world, the basis does, in fact, change between the time a hedge is placed and when it is lifted. Here is what happens when the basis changes.

Assume that the cash price of corn decreases to $2.00, just as in the first scenario; assume also that the futures price decreases to $2.70 rather than $2.45. The basis has now widened from $0.45 to $0.70 ($2.00 − $2.70). For the short (sell) hedge, the loss in the cash market of $22,500 is offset only partially by a $15,000 gain realized in the futures market (equal to 6 contracts \times 5,000 bushels per contract \times the per bushel price decline of $0.50). Consequently, the hedge results in an overall loss of $7,500.

There are two points to note here. First, if the corn farmer had not employed the hedge, the loss would have been $22,500, because the value of 30,000 bushels of corn is $60,000, compared to $82,500 three months earlier. Although the hedge is not a perfect hedge because the basis widened, the loss of $7,500 on the hedged position is less than the loss of $22,500 which would have occurred in the absence of the hedge. So, the hedge did not eliminate all risk: As we said earlier, the hedge substitutes basis risk for price risk. Second, the management of the food processing company faces the same problem from the opposite perspective. An unexpected gain for either participant results in an unexpected loss of equal dollar value for the other. That is, the participants face a zero-sum game. Consequently, the food processing company would realize an overall gain of $7,500 from its long (buy) hedge. This gain represents a gain of $22,500 in the cash market and a realized loss of $15,000 in the futures market.

**Illustrations of Cross Hedging**

Suppose that a zucchini farmer plans to sell 37,500 bushels of zucchini three months from now and that a food processing company plans to purchase the same amount of zucchini three months from now. Each party wants to hedge against price risk, but zucchini futures contracts are not traded. Both parties believe there is a close price relationship between zucchini and corn. Specifically, both parties believe that the cash price of zucchini will be 80% of the cash price of corn. The cash price of zucchini is currently $2.20 per bushel, and the cash price of corn is currently $2.75 per bushel. The futures price of corn is currently $3.20 per bushel.

Let’s examine various scenarios to see how effective the cross hedge will be. In each scenario, the difference
between the cash price of corn and the futures price of corn will be assumed to remain unchanged at −$0.45 over the interval between the time the cross hedge is placed and the time it is lifted. This assumption allows us to highlight the importance of the relationship between the two cash prices at the two times.

We must first determine how many corn futures contracts must be used in the cross hedge. The cash value of 37,500 bushels of zucchini at the cash price of $2.20 per bushel is $82,500. To protect a value of $82,500 using corn futures with a current cash price of $2.75, the price of 30,000 bushels of corn ($82,500/$2.75) must be hedged. Each corn futures contract involves 5,000 bushels, so six corn futures contracts are necessary.

Suppose that the cash prices of zucchini and corn decrease to $1.60 and $2.00 per bushel, respectively, and the futures price of corn decreases to $2.45 per bushel. The relationship between the cash price for zucchini and corn assumed when the cross hedge was placed holds at the time the cross hedge is lifted. That is, the cash price of zucchini is 80% of the cash price of corn. The basis for the cash price of corn and the futures price of corn is still −$0.45 at the time the cross hedge is lifted.

The short cross hedge produces a gain in the futures market of $22,500 and an exactly offset loss in the cash market. The opposite occurs for the long cross hedge. There is neither overall gain nor loss from the cross hedge in this case. That is, we have a perfect cross hedge. The same would occur if we assume that the cash price of both commodities increases by the same percentage and the basis does not change.

Suppose that the cash prices of both commodities decrease, but the cash price of zucchini falls by a greater percentage than the cash price of corn. For example, suppose that the cash price of zucchini falls to $1.30 per bushel while the cash price of corn falls to $2.00 per bushel. The futures price of corn falls to $2.45 so that the basis is not changed. The cash price of zucchini at the time the cross hedge is lifted is 65% of the cash price of corn, rather than 80% as assumed when the cross hedge was constructed.

For the short cross hedge, the loss in the cash market exceeds the realized loss in the futures market by $11,200. For the long cross hedge, the opposite is true. There is an overall gain from the cross hedge of $11,200. Had the cash price of zucchini fallen by less than the decline in the cash price of corn, the short cross hedge would have produced an overall gain, while the long cross hedge would have generated an overall loss.

**KEY TERMS**

- Basis, 29-A–1
- Basis risk, 29-A–1
- Buy hedge, 29-A–1
- Cross hedging, 29-A–1
- Cross-hedging risk, 29-A–1
- Long hedge, 29-A–1
- Perfect (textbook) hedge, 29-A–1
- Sell hedge, 29-A–1
- Short hedge, 29-A–1