

FUTURE PRICES										CASH PRICES					
GRAINS AND OILSEEDS										Monday, April 3, 2000 (Closing Market Quotations) GRAINS AND FEEDS					
	Open	High	Low	Settle	Change	Lifetime High	Low	Open Interest		Lo/Hi Range	Mon	Mon	Fri	Year Ago	
<b>CORN (CBT) 5,000 bu.; cents per bu.</b>										Barley, top-quality Mpls., bu	u2.7	sp	2.7	2.2	
May	236	239 1/4	233 3/4	234 1/4	- 1/4	261	202 1/2	172,739	Bran, wheat middlings, KC ton	u41	46	43.5	53.4		
July	244	248	242 1/2	242 3/4	- 1/4	278 1/2	209	153,801	Corn, No. 2 yel. Cent. Ill. bu	bpu2.115	sp	2.135	2.05		
Sept	252	255	250	250 1/4	- 1/4	257	215 3/4	44,183	Corn Gluten Feed,						
Nov	259	259	255 1/2	255 3/4	- 1/4	260	222 1/2	972	Midwest, ton		42	60	51	53.1	
Dec	260	264 1/4	259 1/4	259 1/2	- 1	279 1/2	225 1/4	108,253	Coarse Meal,						
Mr01	268 1/4	271	267 1/2	267 3/4	- 1	271	233 3/4	12,988	Clksdie, Miss. ton		127.5	sp	125	105	
Dec	271	272	269 1/2	269 3/4	- 1	272	246 1/2	3,671	Hominy Feed, Cent. Ill. ton		55	sp	57	59	
Est vol 68,000; vol Fri 76,212; open Int 501,404, +2,820.										Meal-Bonemeal,		170	180	175	132.5
<b>OATS (CBT) 5,000 bu.; cents per bu.</b>										50% pro. Ill. ton.					
May	124	125 1/2	123	123	+ 3/4	133	112 3/4	4,980	Oats,						
July	121 1/2	123 3/4	121	121	+ 3/4	124 3/4	110 1/2	7,414	No. 2 milling, Mpls., bu	u1.31	1.33	1.3125	1.22		
Sept	124	124 1/2	123	123	+ 1	130	115 3/4	1,584	Sorghum,						
Dec	129 1/2	130	129	129	+ 1	135	115 1/2	3,304	(Milo) No. 2 Gulf cwt	u4.18	4.27	4.275	411.5		
Mr01	.....	.....	.....	135 1/2	+ 3/4	135	129	464	Soybean Meal,						
Est vol 2,600; vol Fri 1,654; open Int 17,749, +133.										Cent. Ill., rail, ton 44%	u166	174	170	132	
<b>SOYBEANS (CBT) 5,000 bu.; cents per bu.</b>										Soybean Meal,					
May	544	554	544	546 1/2	+ 1	554	432	76,777	Cent. Ill., rail, ton 48%	u176	182	179	138		
July	556 1/2	566	556 1/2	558 1/2	+ 1	647	440	59,990	Soybeans,						
Aug	562 1/2	569	561 1/2	561 3/4	+ 1/4	569	441	9,191	No. 1 yel Cent.-Ill. bu	bpu5.175	sp	5.17	4.61		
Sept	568	571 1/2	563 1/2	563 3/4	+ 1/4	571 1/2	450	4,758	Wheat,						
Nov	573	579	571	572	+ 3/2	631	453	37,553	Spring 14%-pro Mpls. bu	u3.575	3.725	3.73	361.5		
Ja01	575 1/4	586	575 1/4	579 1/2	+ 3/2	586	504	2,477	Wheat,						
Mar	585	591 1/2	585	585	+ 3/2	591 1/2	502 1/2	1,551	No. 2 sft red, St.Lou. bu	bpu2.385	sp	2.46	2.495		
Est vol 60,000; vol Fri 72,880; open Int 194,607, +11,245.										Wheat, hard KC. bu		2.725	sp	2.75	3.0375
<b>SOYBEAN MEAL (CBT) 100 tons; \$ per ton.</b>										Wheat,					
										No. 1 sft wht, del Port Ore	u2.86	sp	2.87	3.23	

## FUNDAMENTALS OF HEDGING

This chapter describes how buying and/or selling of futures contracts can be used to reduce some risks associated with price variability of agricultural and food commodities.

The major points of the chapter are:

1. The way a **short hedge** can be used to protect the value of inventories.
2. How **basis**, the difference between cash and futures prices, affects returns to **hedging**.
3. The temporal and locational components of basis.
4. The use of futures markets for target pricing and **long hedging**.
5. The use of futures contracts for **spread and straddle strategies**.

## INTRODUCTION

The first part of this chapter describes how futures markets can be used to obtain a type of price insurance for a commodity. An example of a short hedge is used to illustrate how the effects of a change in the cash price of a commodity can be offset by taking an opposite position in the futures market. Then the effect of imperfect expectations about the difference between cash and futures prices on returns from short hedging are indicated. Temporal and locational components of basis are discussed before turning attention to the use of futures markets to offset other kinds of risks associated with price variation. These uses include target pricing and long hedging. The final part of the chapter indicates how the basic idea of hedging can be extended to profit from expected changes in the difference between two futures market prices.

## UNAVOIDABLE RISKS

Just because farmers' incomes may vary because crop yields are affected by weather conditions does not imply farmers like or prefer risky situations. Most farmers would prefer not to have to gamble on weather, but if they grow crops the uncertainty of weather conditions is something that must be accepted. It does not mean that they necessarily like it, but variable weather is a fact of life. The purchase of crop insurance or investing in irrigation equipment can be viewed as particular business decisions to minimize the risk of certain types of crop failure. The fact that people choose to be involved in risky situations does not necessarily mean they prefer a risky situation over a nonrisky one. It is just that the risky situation is one in which they anticipate that their satisfaction will be maximized because they view the expected payoff to be worth the cost of bearing the risk.

Hedging is one way of using the futures market to avoid some of the effects associated with uncertain prices. Hedging is like an insurance contract in the sense that you might be able to buy some protection against the unknown future price of a commodity. Hedging is not a free good, however, because there is always a cost associated with making a futures market transaction. Costs are associated with having to have a margin account or a sufficient line of credit to participate in a futures market. There are also brokerage fees that must be paid by nonmembers of futures exchanges in order to buy or sell futures contracts.

Producers, processors, or anyone else who buys and sells commodities can use futures markets to possibly reduce some risk associated with price uncertainty. The idea of hedging is related to how futures markets got started in the United States when there was a lot of uncertainty about prices. Futures markets are particular institutions that were created in response to people involved in the trading of agricultural commodities desiring some way of reducing some of the risk of changes in price because of unexpected market developments.

## A SHORT HEDGE

To see how the risk of price changes can be minimized through hedging, some simplistic assumptions will be initially used to illustrate the basic concept. Later some of the initial assumptions will be relaxed to make the illustrations more realistic. To begin, suppose we consider an individual producer or an elevator operator who has sufficient storage capacity to hold a commodity from the time it is harvested until sometime later in the marketing year. The person would like to be able to earn a return for providing the services of helping to even out the flow of the commodity to consumers from when it is produced until when it is needed for consumption. Assume this individual does not want to gamble on what the price of the commodity is going to do while he owns it, but rather would be satisfied if he could earn a normal return for helping to even out the flow of the commodity into market channels. Suppose that the costs of storage from harvest until May are \$.25 per bushel. If the business has a storage capacity of 500,000 bushels, it means that the person would like to know that he could make \$125,000 by putting the grain in storage in the fall and taking it out of storage in the spring. One way that this could occur is if the price of the commodity happened to be \$.25 per bushel higher in the spring than when it is harvested in the fall. For example, if the price of the commodity is \$3.50 per bushel in the fall, the person would be happy with a price of \$3.75 per bushel in the spring. If that change in price occurred, it would be just the right amount to provide returns to cover the costs of this operation.

What certainty is there, however, that if storage is undertaken in the fall that the price will be exactly \$.25 per bushel higher in the spring? There is no certainty. Storing grain in the fall without knowing what it will be sold for next spring is risky. If this operation is undertaken, the owner is subjecting himself to some variability in income because of the possible variability of price while the commodity is stored. The price might be higher or lower than \$3.75 in the spring because no one knows with certainty what will happen to the price between the fall and spring. There could be all sorts of developments in the world that could cause the price to rise more than \$.25 or less than \$.25 per bushel. In fact, there is nothing that says the price has to go up. It could drop to \$3. If the price were to go up to \$3.60 by the spring, the return to storage operations would be less than half of what it should be. On the other hand, if the price goes up to \$4.00, then the return would be \$250,000. The owner of the storage facilities might be perfectly happy to accept the risk associated with these unknown outcomes. On the other hand, he might prefer to have a little more certainty about his income even if it cost him a little money. How might he achieve this objective?

Let us suppose that a futures market exists for the commodity that is being stored. In the fall, assume that the cash market price is \$3.50 per bushel when the grain is put into storage. If participants in the futures market are rational and realize that it will cost about \$.25 per bushel to hold the commodity from the fall until spring, the price of a May futures contract at harvest time ought to be in the neighborhood of about \$3.75. Since a buyer would incur a storage cost if grain to be used the following spring is purchased at harvest time, it is reason-

able to expect to have to pay more for the commodity next spring. Thus, it would be reasonable to assume that the price of a May futures contract would be about \$.25 per bushel above the cash price in the fall to reflect the carrying charge.

In order to hedge against uncertain price movements, an individual should take exactly the opposite position in the futures market that has been taken in the cash market. That is, if a grain elevator operator has purchased grain in the cash market, he would want to sell or go short in the futures market. The idea of hedging is to have offsetting positions in the cash and futures markets. When you sell in the cash market, you buy in the futures market. In the case of an elevator operator, the individual is initially buying in the cash market so he would want to sell in the futures market in the fall to establish a short hedge. Thus, if it is assumed that the hedge is established on October 15, the individual's transactions in the two markets would be the following:

<b>TIME</b>	<b>CASH MARKET</b>	<b>FUTURES MARKET</b>
October 15	Buy (or own) at \$3.50 per bushel	Sell May contracts at \$3.75 per bushel

Assuming that there were no major developments to change price expectations from October until May, when May 15 arrived the person holding the commodity ought to be able to sell it for \$3.75 per bushel. Whenever the cash commodity is sold, he would buy futures contracts to offset any continuing obligation in the futures market. So, when he sold the grain, he would buy futures contracts at \$3.75 per bushel. The \$3.75 price per bushel in the spring assumes that nothing has happened to change people's perceptions of what the value of grain is from what traders anticipated several months earlier.

In this example it is assumed that the cash price is the same as the futures price in the spring. The reason for this is that we are considering a futures contract that is close to expiration. In May the price of a May contract should be very close to the cash price because when the contract expires the physical commodity at delivery points becomes a perfect substitute for the futures contract and vice versa. The reason that hedging provides some income certainty to participants in commodity markets is because of the relationship that exists between futures and cash prices of commodities. The reason for the relationship is because when futures contracts expire, the physical commodity is a perfect substitute for the futures contract at least at the point(s) of delivery specified in the contract. Consequently, when the future contract terminates, the cash and futures prices of goods with exactly the same quality characteristics have got to be the same. If the two prices differed, individuals would prefer to buy the lower-priced item and immediately convert it into a higher valued asset.

When a futures contract matures, locational differentials among cash prices could cause a difference between the futures prices and cash prices at nondelivery point locations. The cash price in North Carolina is not likely to be the same as the cash price in Chicago because of the cost of transporting the commodity. This will be discussed in more detail later. To illustrate the major points of a hedging strategy, it is easiest to assume for the time being that the cash transactions

occur at a delivery point for the futures contract so there would be no transportation costs involved in using the physical commodity to satisfy the futures market objective.

Given the above assumptions, let us see how the individual came out by transacting in the futures and cash markets. To facilitate this calculation, the set of transactions can be updated using the following format:

TIME	CASH MARKET	FUTURES MARKET
October 15	Buy (or own) at \$3.50 per bushel	Sell May contracts at \$3.75 per bushel
May 15	Sell at \$3.75 per bushel	Buy May contracts at \$3.75 per bushel

Examining the above transactions, it is clear that \$.25 per bushel was made in the cash market because prices behaved in exactly the correct manner to cover the storage costs. The futures market transaction gave the person a zero return because he bought and sold at the same price.<sup>1</sup>

In this example, the short hedge accomplished what was desired. That is, a return of \$.25 per bushel was obtained at some cost. If the person had been sure (e.g., perfect price expectations) that the price was going to be \$3.75 per bushel in the spring, there would have been no need to use the futures market.

### **Imperfect Price Expectations**

Now let us suppose that things are more variable. Suppose that between the time the grain is put in storage and the spring, the market realizes that there is going to be an unusually big crop in Argentina or Brazil, or the world is in a recession and not as much grain will be demanded as previously thought, or other things occur that depress the price. Suppose that the cash price goes up by May but only to \$3.60 per bushel. Thus, when the grain is sold in the spring it is worth \$3.60, not \$3.75 per bushel. Economic events that depress the cash market would also tend to depress the futures market because when the futures contract expires, the cash commodity becomes a perfect substitute for the futures contract. Thus, when the grain was sold in the cash market at \$3.60 per bushel, the May contract would probably also be selling for \$3.60 per bushel. Thus, the person would be able to buy futures contracts at that price. In order to see how the individual comes out in this situation, the new prices can be inserted in the tabulation of trades as follows:

TIME	CASH MARKET	FUTURES MARKET
October 15	Buy (or own) at \$3.50 per bushel	Sell May contracts at \$3.75 per bushel
May 15	Sell at \$3.60 per bushel	Buy May contracts at \$3.60 per bushel

In this situation, \$.10 per bushel is made in the cash market because the person bought at \$3.50 per bushel and sold at \$3.60 per bushel. Also, \$.15 per bushel is made in the futures market. Each contract was sold at \$3.75 per bushel and others were bought at \$3.60 per bushel. If you add the returns in the cash market to that of the futures market he still has \$.25 per bushel. If he had not participated in the futures market less than half the amount of money needed to cover the normal cost of operations would have been realized.

Another way of looking at the previous example is that the producer initially expected to be able to sell in the cash market at \$3.75 per bushel. By selling at \$3.60 rather than \$3.75 he made \$.15 less than he expected on the storage activity. On the other hand, by being able to buy back futures contracts at \$3.60 rather than \$3.75, the producer realized an unexpected gain of \$.15 per bushel in the futures market. Thus his less than expected gain in the cash market was compensated by a greater than expected gain in the futures market resulting in the same total return as if he had been able to sell in the cash market at \$3.75 per unit.

Suppose now that something happens to cause the price to go much higher than anticipated. Perhaps a new disease occurs that means not as much grain will be available this year or a war breaks out creating increased scarcity in the market. Suppose the price increases to \$4.00 per bushel by spring. In this case, a hedger would have made \$.50 a bushel by storing the grain, but he would lose \$.25 per bushel on his futures transactions. Again, however, he comes out with a net return of \$.25 per bushel or \$125,000 to cover the costs of operation. In this case, had he known with certainty that a \$4.00 per bushel price was going to occur, he would have been better off if he had never heard of futures markets. The dilemma is that there is some probability that the price could have been \$3.00 instead of \$4.00 per bushel. A \$3.00 per bushel price would have produced a loss of \$250,000 had he not participated in the futures market because of the change in value of the commodity. This example suggests that \$125,000 of income is going to occur with certainty regardless of what happens to the price because offsetting positions were taken in the two markets.

The basic principle of hedging is to take an offsetting position in cash and futures markets so that an unfavorable price movement in one market is offset by the effects of the price movement in the other market. It is a way of removing some of the uncertainty associated with whether the price of a commodity is going to increase or decrease. The reason hedging works is because of the offsetting positions in the two markets. In order to hedge, whenever an action is taken in the cash market, the opposite action must be taken in the futures market. For example, if you are long in the cash market you should be short in the futures market in order for a hedge to work.<sup>2</sup>

Unfortunately, when price relationships in the real world are considered, things do not always work out as nicely as the above examples. Other factors must be introduced that complicate the comparisons, but the principle is the same. If the basic principle of how offsetting positions in the two markets operate is understood, then complications are not so difficult to handle.

### **Locational Price Differentials**

One complication that arises with actual situations is the fact that the relationship between the cash and futures prices may not always behave as nicely as illustrated in the previous examples. Suppose that we consider a cash market that is different from a delivery point specified in a futures contract. In this case, the relationship between the cash and futures prices in the month the futures contract expires that was assumed in the previous examples, may no longer hold. The cash price may differ from the futures contract price even at expiration because of locational price differences. Cash and futures prices ought to move together but when a futures contract expires, the cash price at a given location could differ from the futures price based on what it costs to move the commodity between markets. The prices for the two markets would never differ by more than the transportation charge because if the difference in prices was any larger, there would be some profit to be made by moving the commodity between locations. Traders know that the cash price at any location at the time the futures contract expires will not differ from the futures price by more than the costs of transportation because entrepreneurs will make sure there are no unusual returns to be made from moving the commodity.

### **Temporal Difference**

In the earlier illustrations when the hedge was established it was assumed that the difference between the futures and cash prices was exactly equal to what it was going to cost to store the grain. There may be some other factors that cause the difference between futures and cash prices to differ from the full carrying charge when an initial position is established in the futures market. Local market conditions could influence the cash price in the fall to cause the difference between futures and cash prices to be different from full storage costs. For example, if there is a large harvest and producers are financially strapped because of debt payments and so on, they might be willing to sell the commodity a little faster than the marketing channels would like to take it causing the current cash price to be depressed a little more than what it otherwise would be. In these circumstances, the difference between the futures and cash prices might actually be greater than what it would normally cost to store the grain from harvest to next May.

In other cases, there may be special circumstances such as a later than usual harvest or bigger than usual local demand that cause the cash price to be bid up temporarily. A higher local cash price could result in the difference between the cash and futures prices being less than storage costs.

### **Changes in Basis**

The thing that is critical in hedging is the relationship that exists between the futures and cash prices when the hedge is established compared to the relation-

ship that exists between the two prices when the hedge is lifted. If we return to our initial example, suppose that the cash price had been \$3.55 per bushel instead of \$3.50 per bushel in the fall when the commodity was placed in storage. If everything else was exactly the same in terms of a \$3.75 per bushel futures price in the fall and a \$3.75 cash and futures price in the spring, the business would have grossed \$.20 rather than \$.25 per bushel. The smaller return occurs because the difference between the two prices that existed when the hedge was established was less than the full carrying charge. The operator would not be able to guarantee a full \$.25 per bushel by the hedging operation because of the initial price difference.

If market conditions resulted in the cash and futures prices increasing to \$4.00 per bushel between the fall and spring, the trader would make \$.45 per bushel from the cash market transactions, but lose \$.25 per bushel in the futures market or again end up with a return of \$.20 per bushel.

In fact, you can select any value you want for cash and futures prices in the spring and a net gain of \$.20 as opposed to \$.25 per bushel would occur provided the cash and futures market prices in the spring were identical. The reason this result occurs is because the initial relationship between the cash and the futures prices when the hedge was set up is different from the original example. Thus, the return from hedging depends heavily on changes in the relationship between the futures and cash prices or the basis.

In the above examples, the basis when the hedges were established in the fall was either \$.25 or \$.20 per bushel. In the trade, these would be referred to as negative numbers to indicate that the cash price was below the futures price. For ease of mathematical calculation (in order to subtract a smaller number from a larger one), however, basis can be algebraically defined as the difference between futures and cash prices as follows:

Eq 15-1

$$B_t = F_t - P_t$$

where

$B_t$  = basis at time  $t$  for a specific futures contract and cash market

$F_t$  = price of a specific futures contract at time  $t$

$P_t$  = cash price in a specific market at time  $t$

To be consistent with the way basis terminology is used in the trade, the above equation would need to be multiplied by a minus sign. That operation is equivalent to reversing the terms on the right-hand side of the equation in which case the expression results in a larger value being subtracted from a smaller one. Thus, it is easier to think of subtracting a smaller value from a larger one and attaching a negative sign to the numerical value if desired to be consistent with trade terminology.

The relevant basis for a particular futures contract on a given day can differ depending on which specific cash market is being considered. Every hedger

is primarily concerned about the basis for the specific cash market in which they do business. The basis for a specific location will change over time as prices in the futures market and cash market adjust to new market information. In the above hedging examples, a zero basis was consistently assumed to exist when the hedge was lifted. This may not be realistic even at the time the futures contract expires if the trader's relevant cash price is for a market that is not a delivery point for the futures contract. Location differentials in prices because of transportation costs indicate that the physical commodity at one place is not a perfect substitute for fulfilling an obligation of a maturing futures contract that requires delivery at specific sites. Thus, it is important for a hedger to consider what the relationship between the futures price and his local cash market price is likely to be when he gets ready to lift his hedge. He really is not concerned with whether commodity prices increase or decrease while the inventory is hedged. The key to his gross return is whether the relationship between the futures and cash prices change over time by a sufficient amount to cover the cost of storage.

### THE ALGEBRA OF HEDGING

The outcome of short hedging can be demonstrated algebraically using general notation for any set of prices. That is, by letting  $F_t$  and  $P_t$  represent the futures and cash prices respectively at time  $t$ , a short hedge can be represented as follows:

TIME	CASH MARKET	FUTURES MARKET
1	Buy at $P_1$	Sell at $F_1$
2	Sell at $P_2$	Buy at $F_2$

The profit (or loss) per unit traded in the cash market therefore is the difference between  $(P_2)$ , the price at time 2, and  $(P_1)$ , the price at time 1 or  $P_2 - P_1$ . Similarly, the profit (or loss) per unit traded in the futures market is  $F_1 - F_2$  (remembering profit is the difference between the selling and buying prices). Assuming the same quantity of product is traded in each market means the net return per unit from the hedging operation can be expressed by adding the two expressions together. That is,

Eq 15-2

$$15.2 \text{ Gross return (or loss) per unit} = (P_2 - P_1) + (F_1 - F_2).$$

Rearranging the terms and using the above algebraic definition of basis allows the gross return to be expressed (or loss) per unit in terms of the change in basis between time periods 1 and 2.

Eq 15-3

$$15.3 \text{ Gross return} = (F_1 - P_1) - (F_2 - P_2) = B_1 - B_2$$

As long as  $B_2$  is less than  $B_1$  (as assumed in all of the previous numerical examples) a positive return to short hedging occurs regardless of whether prices increase, decrease, or stay the same. This expression indicates why hedging can be described as replacing the variability in prices with variability in basis. Be-

fore a hedge is established, the individual can check the Internet or call his broker to determine what  $F_1$  is and compare it to the existing local price to determine  $B_1$  precisely. When a hedge is established, however,  $B_2$  is not known with certainty because its magnitude will depend on future developments. However, there is usually much less uncertainty about what will happen to  $B_2$  than what can happen to the overall price levels. This is because of the interrelationships between futures and cash prices previously discussed. To illustrate the fact that gross returns can not be predicted with certainty even with hedging, it is useful to put an asterisk on  $B_2$  to differentiate an expected basis from an actual basis. Thus, anticipated gross returns per unit from a short hedge can be expressed as  $B_1 - B_2^*$  where  $B_2^*$  represents the best estimate at time 1 of what  $B_2$  is expected to be. The actual return per unit to a short hedge is equal to  $B_1 - B_2$ , but this can not be calculated until time 2, or after the fact.

In order to make reasonable predictions of basis, it is important to study historical relationships between futures and cash prices for the cash market of interest. In this way, some evidence can be obtained on how the basis for the particular local market of interest has varied in the past.

## TARGET PRICING

Once the principle of short hedging is understood, it is easy to see how producers can use futures markets to “lock-in” or target price future production. Many farmers have an interest in what price they are likely to receive for their production before they invest their time and effort and perhaps somebody else’s money in some agricultural enterprise. Producers may use some type of forward contract to guarantee a price. This involves getting a commitment from someone that guarantees them a fixed price for the commodity when it is ready to be sold. There are many different ways in which forward contracts or commitments are negotiated between two parties.

Futures markets provide producers an alternative to forward contracts to obtain some price certainty. Futures markets can be used to accomplish the same objective as a forward contract but they do not lock a producer into a specific sale of the physical product as a forward contract does. The idea of target pricing is also useful to evaluate alternative uses of resources at planting time. If a producer does not obtain a forward contract or use the futures market, he accepts some risk in terms of what the price will be when the commodity is harvested and ready for sale unless the government guarantees or fixes the price. If this type of price uncertainty is too risky in terms of an individual’s preferences, he might want to check what the current prices of futures contracts expiring next fall are for commodities that he is considering producing. This would simply indicate what the futures markets are suggesting about likely prices of these commodities next fall. Using this information for planting decisions is similar to the example considered previously, except the physical commodity does not exist yet. Making a planting decision in the spring, however, is equivalent to making a commitment

in the cash market in terms of certain costs of production. When a decision is made to grow a commodity or go into a livestock feeding or production activity, it is similar to buying the commodity at some cost even though you are not physically purchasing so many bushels of corn or so many hundred hogs. A commitment is being made, however, as far as what the production activity is going to cost. When a production activity is undertaken that will eventually result in a long position in the cash market, an offsetting position in the futures market could be established to lock in a price by selling a futures contract. Selling in the futures market establishes an offsetting position even though you do not have the physical commodity in hand, but hope to have it barring unknown weather conditions or other unforeseen elements.

In the spring, producers may decide that a particular fall futures contract offers an attractive price. If they knew with certainty that they were going to get a given price for the commodity, they could easily calculate the profitability. After the planting decision is made and a futures contract has been sold, it is almost like locking in a fixed price for the commodity being produced. When the commodity is harvested or ready to be sold, producers can sell the physical commodity on their local cash market and simultaneously buy a futures contract to offset their position in the futures market. As long as they buy the same number of contracts in the futures market that they sold, they have no continuing obligation in the futures market. As far as the physical commodity is concerned, they can sell it in exactly the same way as if they had not participated in the futures market. The gross returns they make in the cash market are determined by whatever price exists in the local market. If the cash price exceeds their per unit costs of production, a profit has been made. This is not their only source of profit (or loss), however, if they have simultaneously traded in the futures market. If they sold a futures contract at a price of  $F_1$  per unit and bought another one at a price of  $F_2$  per unit, the extra profit (or loss) is  $F_1 - F_2$  per unit. This information can be set up in a table as follows:

TIME PERIOD	CASH MARKET	FUTURES MARKET
At planting time	Produce at $C_1$ (estimated cost per unit)	Sell at $F_1$
Harvest or later	Sell at $P_2$	Buy at $F_2$

One difference in the above example from that considered earlier is that initially the producer makes a commitment to produce at a cost of  $C_1$  per unit rather than physically owning or buying the commodity. Although the producer may have a fairly accurate idea of what his total production costs will be, the cost per unit of production will be uncertain to the extent that total output is variable. Output uncertainty is ignored for the time being.

The net return for the above set of transactions can be expressed as  $(P_2 - C_1)$  for the cash market and  $(F_1 - F_2)$  for the futures market. Adding the two components results in a net return per unit of  $(P_2 - C_1) + (F_1 - F_2)$ . After rearranging the terms in the preceding expression to  $F_1 - (F_2 - P_2) - C_1$

and replacing  $F_2 - P_2$  by  $B_2^*$ , the net return per unit of production can be represented as  $F_1 - B_2^* - C_1$ . By taking the initial position in the futures market, the producer essentially locks himself in or is establishing a target price of  $F_1 - B_2^*$  for the commodity. It does not really matter what happens to the price in the cash or futures markets between the time production is initiated and when the output is ready to be sold because his projected gross price per unit is  $F_1 - B_2^*$ . The only thing that is uncertain is the basis that will exist when he gets ready to sell his production. When the producer is making his initial decision, he knows what  $F_1$  is. There is no doubt about that. His only uncertainty is about  $B_2$ . He can not predict  $B_2$  perfectly, but by studying the relationship between prices in a particular local market and the futures market in the past, he may be able to get a pretty good idea of the possible range of variation in  $B_2^*$ .

An advantage of using futures markets relative to taking a chance on cash prices is that the variability of the basis is generally much less than the variability in the price. In this way, using the futures market is like buying insurance. It will involve some costs, but the reduction in uncertainty may be worth it. Securing forward contracts may also be costly in terms of the time it may take to negotiate a contract involving particular conditions that the two parties agree to. On the other hand, an individual may prefer to just take his chances on what happens to market prices. He may decide that this alternative might be optimal after evaluating his expectations and risk preferences. If producers need to finance production costs, lenders may prefer that producers have a forward contract or use the futures market to target price output in order to guarantee profitability in terms of a "three party agreement." Lenders may not want to extend credit if there is a chance the market price will go down. They may want to make sure the producer is locked in at a particular price to make sure a loan can be paid after harvest.

In order to keep the algebra simple for the above example, it was assumed that the producer would sell exactly the same quantity in the futures market as he anticipated producing. This, of course, may not be feasible because of the discrete units in which futures contracts are traded. For example, a producer anticipating 12,500 bushels of corn would not be able to sell futures contracts for exactly that quantity. Furthermore, the uncertainty associated with the actual quantity of production that will be available to sell because of weather and other uncontrollable postplanting factors often means it may be unwise for producers to make a forward commitment for all of their expected output.<sup>3</sup> There is no universal rule as to what fraction of anticipated output is optimal to forward sell. The results of most studies involving alternative assumptions about market conditions suggest a range of 60% to 75% of expected output as an optimal amount to forward sell on the futures market.

Now let us consider how target pricing works using some actual numbers. Suppose in the spring a producer sells a November soybean contract at a price of \$6.25 per bushel. In the fall when the crop is ready for harvest, suppose the price of soybeans is \$5.50 per bushel because of a bumper crop. If he had not used the futures market, he would get only \$5.50 per bushel. If the cash price

decreased between planting time until harvest, chances are the futures price would also have gone down perhaps to \$5.75 per bushel. Assuming a harvest time basis ( $F_2 - P_2$ ) of \$.25 per bushel, how does he come out? He gets \$6.25 minus \$.25 so he ends up with a net price of \$6.00 per bushel. His neighbors who did not know anything about the futures market would end up getting \$5.50 per bushel.

Suppose now that the cash price at harvest time had increased to \$6.50 per bushel. How does the producer using the futures market end up? He still gets \$6.00 per bushel assuming a harvest time basis of \$.25 per bushel. His neighbors who did not use the futures market end up receiving \$6.50 per bushel. In evaluating these results it is important to remember what the person's original motivation was for using the futures market. The futures market was selected to avoid speculating or gambling about what the product's price was going to be at harvest time. The futures market was used to obtain a little more certainty in net returns regardless of what happens to prices.

## LONG HEDGING

The type of hedging discussed in the beginning of this chapter as well as the example of how producers can use the futures market to target price their output, initially involved establishing a short position in the futures market to offset a long (or potentially long) position in the cash market. Suppose now that the initial position in the cash market is a short position. How could that occur? Suppose you are an exporter and have just negotiated a sale of grain to another country (e.g., Japan) but the buyer does not want the product delivered for another 6 months. As an exporter, you have made a commitment agreeing to sell a commodity that you may not have and furthermore, you may not want to own until you have to ship it. If you buy the commodity now, you will be tying up some money for a period of time. What you would prefer to do is wait and buy the commodity closer to the delivery time and use your capital for other purposes in the meantime.

Another example is if a firm processing an agricultural commodity makes an agreement with a retail chain to provide a specified quantity of a product at a fixed price 6 months from now. In both cases, an agreement is established at the present time that specifies the sale of a physical commodity to be delivered at a specified price sometime in the future. In essence, the agreements establish short positions in the cash market.

In such situations it would be desirable to take offsetting positions in the futures market to provide protection against unexpected changes that may occur in the cash price of the commodity. To take an offsetting position in the futures market requires the purchase of a futures contract equal to the quantity sold forward in the cash market. This would be establishing a **long hedge** because the initial position in the futures market is a long position. When it is time to deliver the physical commodity to the eventual purchaser, the cash market

price might be higher or lower than what had been anticipated when the initial commitment was made. Assuming that prices in the cash and futures markets move together means that unanticipated gains (or losses) in one market would tend to be offset by unanticipated losses (or gains) in the other market.

This type of hedge can be analyzed algebraically similar to what was done before. The sequence of operations for a long hedge include the following:

TIME	CASH MARKET	FUTURES MARKET
1	Sell at $C_1$	Buy at $F_1$
2	Buy at $P_2$	Sell at $F_2$

where  $C_1$  is the cash price per unit that will be received when the commodity is delivered. The net return from this combination of trades is  $(C_1 - P_2) + (F_2 - F_1)$ . Rearranging the terms in the last expression leads to  $(F_2 - P_2) - (F_1 - C_1) = B_2^* - (F_1 - C_1)$ . In this formulation, the key unknown element becomes what the expected basis is going to be when the commodity is purchased for delivery and the hedge is no longer needed. The difference between the current futures price and the price specified in the forward sale ( $C_1$ ) is known with certainty when the initial terms of the contract are specified. This difference is like a basis in one respect, in that it involves a difference between futures and cash prices. It is not a basis, however, because  $C_1$  is a negotiated price at which the commodity will be sold in the future and may differ from what the current cash price is.

## FUTURES MARKET EQUILIBRIUM

When considering why some traders are short hedgers and others are long hedgers, it is possible to see how a market for futures contracts could exist even without any speculators. Thus, futures trading is not necessarily just a case of risk averse individuals transferring some price risk to speculators who are willing to assume it. Of course, the potential profit from unexpected price movements that can accrue to speculators provides an incentive for speculators to participate in futures trading and adds liquidity to futures markets. Any time there are short hedgers who desire to sell futures contracts and simultaneously long hedgers who want to buy futures contracts, a market could exist. Thus futures markets are a way of mutually satisfying individuals who have interests in taking opposite directions in future ownership of a commodity. People with different interests in a particular commodity are able to negotiate contracts to limit their exposure to price uncertainty through futures markets. Futures markets can provide protection against unusual fluctuations in the cash price after a commitment to produce, buy, or sell the physical commodity has been made. Traders may want protection against unusually large losses at the cost of giving up unusually large profits in order to have more stability in their incomes. Futures markets also provide a mechanism for other individuals to profit by speculating on unknown price changes of commodities.

## SPREAD AND STRADDLE STRATEGIES

Once the basic idea of hedging is understood, the world is practically unlimited as far as other trading possibilities involving transactions in more than one market. Instead of the relationship between the cash and the futures market for a given commodity being the key element as in the previous examples, the relevant price difference might be between two futures contracts in the same market or two different futures markets. For example, one could be trading May and November contracts for the same commodity at the same time in a given futures market. This is usually referred to as **spreading**. Initially, what might be done, for example, is simultaneously sell a May contract and buy a November contract. Then sometime later to fulfill the obligations in the futures markets for each contract, the opposite actions are taken. After the second set of transactions, the individual would be out of the market as far as the May and November contracts are concerned. Why might this sequence of transactions be of interest? If you think the price relationship between these two markets is going to change but are not sure whether prices in general will increase or decrease, spreading offers an opportunity to make money. Algebraically these ideas can be expressed as follows:

TIME	MARKET A	MARKET B
1	Buy at $A_1$	Sell at $B_1$
2	Sell at $A_2$	Buy at $B_2$

The return from this combination of trades is  $(A_2 - A_1) + (B_1 - B_2)$  or  $(B_1 - A_1) - (B_2 - A_2)$ . Letting  $S_1 = B_1 - A_1$  or the spread between the two markets, the return can be represented as  $S_1 - S_2^*$ . An asterisk attached to  $S_2$  indicates that in evaluating the potential profitability of such a combination of trades,  $A_1$  and  $B_1$  are known with certainty, but one must predict  $A_2$  and  $B_2$  or a value for  $S_2$  to estimate profitability.  $S_1$  is known with certainty because it is based on current prices. If  $S_1$  is bigger than  $S_2^*$ , then some potential profit is associated with the above sequence of trades. On the other hand, if  $S_1$  is smaller than  $S_2^*$  (or what  $S_2$  actually turns out to be), the above combination of transactions would be unprofitable. In the latter case, the potential or actual loss could be converted to a gain by reversing the order of transactions. That is, initially sell in Market A and buy in Market B. In this case, the sequence of operations would be:

TIME	MARKET A	MARKET B
1	Sell at $A_1$	Buy at $B_1$
2	Buy at $A_2$	Sell at $B_2$

The net outcome of this sequence of trades is  $(A_1 - A_2) + (B_2 - B_1)$  or  $(B_2 - A_2) - (B_1 - A_1) = S_2^* - S_1$ .

Thus, the appropriate sequence of buying and selling actions in the two markets depends on how one anticipates the price difference that currently exists between the two markets to compare to the price difference at some future date. There is no guarantee that price relationships will always change in particular ways, but people who follow market prices on a regular basis are often more successful in identifying how the relationship between two prices is likely to behave than in predicting whether prices in general will rise or fall. The existence of a profit potential through simultaneously trading in different contracts in the same commodity (spreading) or in different markets (**straddling**) helps keep price relationships from deviating too far from the values dictated by economic factors associated with time, space, or form values of physical commodities.

## SUMMARY

The ownership of any commodity subject to price variability involves considerable risk. The use of futures markets can reduce some of this risk. Taking a position in a futures contract opposite from the cash market position offers some protection against unexpected changes in price of a commodity. A short hedge, for example, involves the selling of a futures contract to protect against possible decreases in the price of a commodity that is owned. The reason hedging provides some price insurance is because cash and futures prices for the same commodity generally move in the same direction. This means that if the physical commodity loses value because of a drop in price, profit is likely to result from short positions in the futures market.

The net return from hedging depends on what actually happens to the difference in cash and futures prices during the time the hedge is in place. The difference between a particular futures price and a cash price for a specific market on a given day is known as the basis. The basis for a given cash market is influenced by locational and time elements. The time component diminishes the closer a futures contract is to maturity. The locational component depends on the cost of transporting a commodity between a specific cash market and delivery points specified in the futures contract. Basis variability is generally less than price variability and is why hedging tends to offer some protection against unknown changes in price.

Futures markets can also be used to lock-in or target price agricultural commodities before they are produced. The sale of a futures contract at the time production decisions are made essentially determines the price that will be realized when the commodity is actually ready for sale. The only uncertainty is what the basis will be at the particular cash market when the commodity is sold. Analysis of historical basis behavior may be useful in establishing some guidelines about what might be expected for given markets.

Another use of futures markets to minimize price uncertainty is to simultaneously purchase futures contracts at the time a commitment is made to

deliver a commodity at a fixed price at some time in the future. To acquire price protection for these situations requires the purchase of futures contracts, and this is why it is referred to as a long hedge. Long hedging is especially useful for exporting firms and agribusinesses who make commitments to provide specific quantities of commodities at specific future times at a predetermined price.

The fact that the net return from hedging depends on what happens to the difference in prices in the two markets is also applicable to consider potential profits associated with transactions involving two or more futures contracts. These can consist of simultaneously buying and selling two different futures contracts and later closing out the positions when the difference in prices has changed. The two futures contracts can be contracts with different maturity months for the same commodity or entirely different commodities.

## QUESTIONS

1. What is the major factor determining whether someone buying and/or selling futures contracts is a speculator or a hedger?
2. Suppose that while you are storing 50,000 bushels of soybeans that you have hedged in the futures market, your local market's cash price declines by \$.40/bu. If your local basis also has changed from \$.45/bu under to \$.35/bu under the futures contract at the same time the cash price has been dropping, what does this indicate about the specific amount of price change that has occurred in the futures market? Explain how you arrive at your answer.
3. Identify and briefly describe the two economic factors that determine the magnitude of the basis for any commodity for which a futures market exists.
4. Assume you sell cattle futures at a price of \$69.00/cwt, later buy a futures contract at \$66.00/cwt, and sell live cattle in the cash market at a price of \$65.00/cwt. What is the net price you realize from this set of transactions (ignoring commissions and other transaction costs)?
5. Assume that when a long hedge is initiated, the local basis is \$.75/unit under the futures price. If the basis becomes larger in absolute value (e.g., \$1.00/unit under the futures price), would this be a favorable or unfavorable development as far as the hedger is concerned? Explain your reasoning.
6. If the current price of November futures contracts in soybeans is \$5.95/bu and a producer expects his local basis will be \$.25 under the November contract next fall when he gets ready to harvest, what price can he try to lock-in by using the futures market?
7. Assume you are employed by the XYZ exporting company and have just negotiated a 20 million bushel sales contract for grain with representatives of China at a fixed price of \$5.50/unit net of shipping costs, but the commodity is not scheduled for delivery until next June.

a. If the current price of June futures of this commodity is \$5.40/unit, briefly explain how your company could use the futures market to make sure a fixed cost of the commodity was locked in to “guarantee” a profit.

b. What action would your firm need to take next spring to fulfill its obligation in the futures market assuming it hedged its commitment when you made the deal with China?

## NOTES

1. Note that this comparison ignores any transaction costs including brokerage fees, the opportunity cost of the margin money required to maintain a position in the futures market, and the possibility of any margin calls while the commodity was being stored.

2. These examples assume that the quantities in the futures market and cash market are identical.

3. In some cases, there may be a possibility of obtaining government or private insurance protection or other alternatives to protect against quantity uncertainty.