ABM 425

LECTURE MATERIAL FOR COMMODITY AND FUTURES MARKETING*

Chapters 2 and 3

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CHAPTER 2
COMMODITY FUTURES AND OPTIONS MARKETS

Futures markets are and have been very important institutions in commodity pricing. These markets have been prominent in the U.S. for more than a century, and precursors of futures can be traced back several centuries in many points around the world (Chicago Board of Trade, 1985). Activity in futures trading has expanded over time with accelerated growth recently in non-agricultural entities--common stock indices, interest rates and exchange rates among others. Called "derivatives" because their pricing is based on the underlying financial instruments, volume of trading on these instruments has exceeded that on commodities.

The focus of Chapter 2 is on a description of commodity futures and options, and Chapter 3 will elaborate on how they are used in forward pricing. Many of the same principles apply to derivatives, but for a more complete discussion of this subject, see An Introduction to Options and Futures, (Chance, 1991) and Futures and Options, Theory and Practice (Stoll and Whaley, 1993).

What are Futures Markets?

One can think of futures markets as very similar to large organized cash markets with many buyers and sellers. Instead of the product being exchanged on the spot, the asking and bidding is over contracts for future delivery. Cash markets dealing in forward contracts do exist, but would not be considered futures markets.

Description

A unique characteristic of futures is that the sellers are not linked with specific buyers, as would be the case in forward contracts. The intermediary between buyer and seller is a "clearing house" which makes certain that contracts held to delivery are fulfilled. In a forward contract market, both buyers and sellers are at some risk relative to "non-performance" of the other party. One party may default, go bankrupt, etc. The system of futures markets does not allow this to happen. Buyers and sellers are guaranteed performance.

If you buy a futures contract, you have a right to take delivery on the cash commodity at a given price in a specified future period and are defined as "long" in that contract. If you sell a futures contract, you have a right to deliver the cash commodity at a given price in a specified future period and are defined as "short" in that contract. Typically, an array of contracts are available which relate to specified months up to two years into the future.

Another feature of futures is that only a small fraction of the volume of trades results in fulfillment of the contract (normally less than three percent). Nearly all trades are "offset" (sellers buy back their contract to deliver, and buyers sell the contract to take delivery before the delivery date).

Actually, futures markets do not want to become cash markets. At the same time, as will be discussed in Chapter 19, it is very important that <u>some</u> deliveries are made. This keeps futures and cash markets in line. For this reason, futures markets provide delivery opportunities, but for most buyers and sellers who deal in the cash commodity, offset is more profitable than delivery.

The market facility is normally provided by a municipality which charges the participants a fee. For example, the City of Chicago owns the Chicago Board of Trade (CBT) and the Chicago Mercantile Exchange (CME). Rules and regulations emanate from several sources, including members of the exchanges, a government agency known as the Commodity Futures Trading Commission (CFTC) and an organization of the brokerage industry itself known as the National Futures Association.

To be more specific, a futures contract has been defined as:

> A legally binding commitment to deliver or take delivery of a given quantity and quality of a commodity, at a price agreed upon when the contract is made, with delivery at the seller's prerogative sometime during the specified future delivery month.

To clarify what may seem to be rather technical in this definition relative to a delivery, a typical system to facilitate the delivery process is as follows: At the beginning of the delivery month, sellers still holding a contract may declare their intentions to deliver. The clearing house matches up the first sellers to make such declaration with the earliest buyers still holding their contracts into the delivery month.

In a futures contract, the basic grade is specified which is the focal point for the price quotations. Delivery of a certain amount of product not meeting that grade is allowed, with set discounts or premiums established. Delivery points are listed along with times deliveries can be made. In a couple of cases, a "cash settlement" alternative is provided but this is the exception. (See Glossary at end of this chapter.)

Futures markets set which months are to be traded. Commercial needs do not require contracts for every month. The markets establish the trading unit, such as the CBT's 5,000 bushels on corn and the CME's 40,000 pounds on live cattle. Minimum price fluctuations in the bidding and asking process are set, such as one-quarter cent per bushel on corn and 2.5 cents per hundredweight on live cattle.

To avoid unwarranted swings in prices, the markets establish maximum daily price fluctuations. In Chicago, this is 12 cents per bushel on corn and $1.50 per hundredweight on cattle. The limit refers to price changes, up or down, during a trading day relative to the closing or settle price of the previous trading day. The rationale is to allow re-assessment of market fundamentals overnight and avoid unfounded panic on a given market day. If the market moves the limit in the same direction in following days, the limit is removed on the logic that the fundamentals justify the market seeking its new level.

Position limits are set for individual traders. This means that upper bounds are established on how many contracts a participant can hold as a buyer or seller. The purpose is to prevent a trader from affecting the market to his or her advantage. This is called "cornering" the market. Other terms are "squeezing" or "pinching." The critical period is usually toward the delivery date when few positions remain open in the market.

How Futures Prices are Quoted

Futures prices are quoted widely in printed and electronic media. Up-to-the-minute quotes are available through electronic media. An example of the type of information published daily is shown in Table 2.1. The contract months for corn at the CBT are March, May, July, September and December. On April 24, 1996, trading was taking place on contracts through 1997. For each contract, the CBT reports the open (beginning of the market day), the high, the low and the settle (closing) price. The change in the settle price on that day relative to the settle on the previous market day is recorded. The open interest is shown for each contract and at the bottom of Table 2.1; totals are given for volume and open interest.

Open interest refers to the number of contracts which must be either offset or delivered. Since longs must equal shorts, open interest equals the number of contracts long or short, not the sum of the two. Volume refers to the number of contracts traded in a given day. Most of the activity had been registered in the July 1996 and December 1996 contracts with only limited trading in 1997 futures.

Who Participates?

Traders in futures contracts can roughly be classified as: (1) speculators and (2) hedgers. Speculators are in the game to profit from a move up or down in the market. They may also speculate on "spreads" in which they buy one futures contract and sell another hoping the difference will change in their favor. Hedgers use the futures primarily to reduce their price risks in dealing with the cash commodity. They may speculate to some extent on the relationship between futures prices and cash prices, but their goal is to avoid the substantial declines or rises in prices often encountered in the commodity market. They accomplish this by taking an opposite position in the futures market to their position in the cash market, which is the essence of hedging.

Table 2.1

Quotations on Corn Futures at the Chicago Board of Trade, 5,000 Bushel Contracts in Cents per Bushel, April 24, 1996[a]

Contract Month	Open	High	Low	Settle	Change	Open Interest
1996						
May	479	488	471	487	+8	55,087
July	461	471	451	470	+10	168,699
September	374	374	366	372	-2	56,545
December	335	335	327	333	-1	129,056
1997						
March	336	339	332	338	-1	13,239
May	336	341	336	329	-2	1,294
July	336	341	336	339	-2	3,447
December	291	294	291	292	0	3,802

Volume 120,978 contracts
Total open interest 341,169 contracts

[a]Prices are rounded to nearest whole number.

Anyone can participate in these markets. Standing in the pits at the CBT or active in other exchanges are floor traders who may be trading in their own account and/or executing buy and sell orders for others. Members on these exchanges must pay a fee to participate, but through brokerage houses (members or connected to members), any person wanting to speculate or hedge can participate if they meet certain financial requirements.

To trade through a broker, an individual must set up a "margin account." A broker will require verification that a speculator has substantial liquidity and be able to handle the risk. Brokers will require that hedgers be legitimate commercial operators in the cash market. Both will have to establish a margin in terms of a cash (or highly liquid) good faith deposit. The amount of the deposit, however, will be only a fraction of the value of the contracts being traded, normally about 5 to 15 percent.

What Commodities are Traded, Where and Why?

A wide variety of commodities and instruments are actively traded in futures markets. Among agricultural products are grains and oilseeds, livestock and meat, dairy products, tropical products such as sugar, coffee and cocoa, frozen orange juice and cotton. Other commodities include metals and petroleum, lumber, and very recently, fertilizer. The most active markets in recent years have been the financials--U.S. Treasury bills and bonds, common stock indices and exchange rates on currencies.

Futures markets are worldwide. In addition to 13 exchanges in the U.S., 12 other nations have futures markets. They include Australia, Brazil, Canada (four), France (three), Hong Kong, Japan (four), Malaysia, The Netherlands, New Zealand, Singapore, Sweden and the United Kingdom (nine).

In reviewing the list of commodities traded in futures markets, certain common characteristics are apparent:

1. Prices are volatile.
2. Products are standardized. Grading is established.

3. Products are broadly produced and marketed.

4. Most products are storable.

Volatility attracts both speculative and hedger interest. Speculators can profit (or lose) in a volatile market but have little opportunity for profit in a stable market. Hedgers need protection in a volatile market but have no need for such protection in a stable market.

Because trading in futures markets focuses on a base grade, with the possibility of delivery, the product must have grades and standards acceptable to the industry. This is particularly important with agricultural commodities which are not easily produced to a particular standard. The distribution across the quality spectrum can vary greatly from year-to-year due to weather.

Products broadly produced and marketed have a better chance of success as actively traded commodities than those with concentrated production areas with few marketing channels. For example, live cattle futures succeeded, but beef carcasses did not, ostensibly because live cattle had a broad production base while beef carcass production was much more concentrated. Navy beans are a candidate for trading, but production and marketing are in relatively few hands. Many speculators who could participate in these markets would feel disadvantaged in the crucial process of gaining market information and would shy away.

At one time, storability was felt to be a prime consideration. Reasons for this related to the delivery process. However, the continuance of live cattle, feeder cattle and hog futures is testimony that storability is not a necessary condition. However, very perishable products such as fresh fruits and vegetables are not viable candidates.

Economic Functions

On the surface, one might wonder whether futures markets were nothing more than gambling casinos--huge lotteries in commodities and financial instruments. In the sense that this institution provides speculators the opportunity to leverage capital in a risky game, there is a grain of truth in this assertion. However, futures markets provide a number of very useful economic functions. They can be enumerated in terms of their role in:

1. Enabling hedgers to transfer price risk to speculators.
2. Facilitating price discovery.
3. Enhancing information collection and dissemination.
4. Assisting in the coordination of economic activity.
5. Stabilizing markets and providing liquidity.
6. Providing flexibility in forward pricing.

Probably the most important function is in risk transfer, which will be covered in some detail in Chapter 3.

Futures markets provide central facilities for buyers and sellers to interact and bring all the forces impinging on price formation together. In many cases, this is a face-to-face confrontation of buyers and sellers in octagonal pits or similar sites. Typically, the trading is by open outcry in a very transparent process. The floor brokers involved are mainly representing the real buyers and sellers, who may be from all parts of the world. Also active are "scalpers," speculators who seek profits on small price movements and provide liquidity in the markets.

Information needed for effective use of futures markets is so valuable that many resources are devoted to collection and dissemination. This involves both public and private organizations. Within the U.S. Department of Agriculture, the National Agricultural Statistics Service (NASS), and the Market News Branch of the Agricultural Marketing Service (AMS), along with cooperating state counterparts, play a major role in providing comprehensive, unbiased crop and livestock estimates and market information. Private consulting firms and specialized market news services are also prominent. Futures markets themselves collect and make available an extensive amount of data on prices, volume and open interest. Open position data on hedgers, small traders and large traders are also generated and distributed.

Another economic function of futures markets is to help coordinate economic activity. So prevalent is futures price information that commercial houses simply refer to cash prices in terms of relationships to futures (so many cents or dollars per unit over or under futures). This facilitates day-to-day operations in moving products through the system. With prices on products and/or inputs locked in, a firm can devote more energy into the production line operation and increasing efficiency.

Without futures, the process would be more risky and inefficient. The importance of futures in this regard can be observed when, for whatever reason, futures are not operating. This might be due to severe weather at the location of the exchange, limit moves in the contract price, etc. At those times in the grain trade, the comment is often heard that, "elevators are taking protection." This means that being unable to hedge, they widen their margins as they face increased price risks.

The traditional view is that the existence of futures markets helps stabilize prices. Active futures markets are liquid (many buyers and sellers are ever present either on the trading floor or linked to brokerage offices). At times, cash markets can be a bit clumsy allowing gluts in supplies to unduly depress prices. At other times, shortages can move markets above levels warranted by supply-demand conditions.

Some do question whether this is true and cite examples of high volatility in futures at times. Research on commodities that have been on and off of futures trading supports the contention that futures stabilize markets. However, in the very short time context, futures may be less stable because market information can quickly be reflected in price moves as compared to more dispersed and less coordinated cash markets.

Related to the transfer of risk, futures markets provide commercial operators considerable flexibility in forward pricing both products and inputs. They can choose to use futures or not and can decide what proportion of their products and inputs to hedge, determining how much risk they are willing to assume.

<u>Concepts About Futures Not Easily Understood</u>

The first exposure to explanations of futures markets can be bewildering. Because so few futures contracts end up with delivery of the physical product, some novices may see futures as merely "paper trading." This may be amplified to the skeptics if told that the total bushels of corn traded on the CBT in a year often exceeds the total U.S. corn crop! Be that as it may, these contracts are real and performance is required if held to the delivery period.

But what if buyers hold more contracts into the delivery month than there is cash product available? While technically this could be true, the price on these futures would likely have risen enough to entice most of these buyers to sell long before the delivery month. A related question is, "What if many want to sell, but there are few buyers?" The answer is that the price will take care of it. Price will drop to the point where the number of contracts offered for sale will be exactly matched by the number that will be purchased. Price is the equilibrating mechanism.

What happens to contracts purchased that are sold before delivery? Nothing, really. They just vanish. The buyer may have profited or lost in the action, but the contract sold (offset) becomes extinct.

Suppose you bet $100 that a certain major league team would win the World Series. Your team loses the first three games. You go to the other party and offer $60 to cancel the bet. If the other party accepts, the bet is off--just like offset.

When you buy a futures contract, not having sold before, you are "long" on a contract. You are said to be a "long." If you sell a futures contract, not having purchased before, you are "short." You are referred to as a "short," having made a "short sale."

Some have a hard time grasping that you can sell something you don't have, and in the case of futures, don't expect to have in terms of the physical commodities. Short sales, actually, are quite common even in forward contract markets. When you order a new car from a dealer the car may not even be manufactured. You sign a contract to take delivery at a future date, and the dealer signs the contract to furnish the new car. The dealer has made a short sale. You are long. If you contracted to buy a car that was "hot" on the market and deliveries were slow, you might find someone willing to buy your contract and pay you a premium. This is quite similar to the action on futures markets.

Futures markets are easily accessed and are very liquid. Orders can be called in over the phone to the broker involved and executed within minutes on the appropriate exchange. If you buy, say, two soybean futures contracts on the CBT and hold them until you get a delivery notice, they won't dump 10,000 bushels in your front yard. You will simply start paying storage costs at a warehouse somewhere in the rail switching district of Chicago, or as an alternative delivery point, Toledo. You will have to decide when to sell 10,000 bushels of cash soybeans.

If soybean futures are trading at $6.00 per bushel, 10,000 bushels would be valued at $60,000. How much money would you have to deposit in a margin account to buy (or sell) $60,000 worth of soybean futures? Margins vary, but in this case, could be as low as $3,000--only five percent of the value of the contract. Can you name any other investment where you could leverage your money 20-fold?

If soybean prices were to increase by 30 cents per bushel, your purchase would show a $3,000 profit--double your money. If soybean futures dropped 30 cents, you would lose all your margin.

But, before this 30-cent drop would happen, you would receive a "margin call" from your broker. You would be called the day after the equity in your account dropped to about 75 percent of the initial level and be required to bring your margin back to the initial level. In other words, if soybean prices dropped by more than about eight cents a bushel after you bought the contracts, you would have to add the difference between your current equity and $3,000. On the other hand, if soybean futures were to rise, you would be able to draw off any amount in your margin account over $3,000.

At the close of each business day, the clearing houses in futures "mark to the market." This means that they bring records up to date with all of the member brokerages. Because both buying and selling are involved, each brokerage has a net long or short position with the clearing house. To protect themselves, each brokerage makes certain that their clients have maintained the required margin, or if not, can do so the following day. If clients cannot bring their margins up to the initial level, they are "closed out" (their position in the market is quickly liquidated). They are denied the opportunity to recoup their losses in the market, or, mercifully, kept from losing more.

In this example, the assumption was made that you bought soybean futures, or established a long position. This you would do if you expected prices to rise, that is, you were "bullish". On the other hand, if you had expected prices to fall, that is, you were "bearish," you would have sold short.

Options on Futures

"Options" are another marketing tool in agriculture and are not really new to the scene. Stock options have been trading for a number of years in the U.S., as have certain agricultural options outside the U.S. Irregularities in trading in options on U.S. agricultural commodities in the 1930's resulted in their being banned. They were re-introduced in 1984 on a pilot basis in several futures exchanges and now have become an established adjunct to futures. To understand options, a number of definitions are needed. The glossary at the end of this chapter provides clarification for both futures and options.

Essentially, commodity options provide the "opportunity," but not the "obligation" to sell or buy a commodity at a certain price. In the markets to be described, the underlying commodity is a futures contract and not the physical commodity.

There are two types of options, "puts" and "calls." A put is a contract that gives the holder the right to sell at a specific price--"to put it on them." A call is a contract that gives the holder the right to buy at a specified price--"to call from them." (See McKissick, Shumaker and Williams, 1984).

The option's buyer (holder) is the person who obtains the rights conveyed by the option. The option seller (grantor or writer) is the person who grants the rights contained in it. In the options markets, there are: (1) buyers and sellers of puts, and (2) buyers and sellers of calls (two different markets).

The specified price is called the exercise or strike price. The bidding is manifested in the option premium, which is the market value of the option. A buyer pays the premium for the right to sell or buy futures at the indicated strike price. In a sense, the option premium is the cost of price insurance.

The "intrinsic value" of an option is the positive difference between the strike price and the underlying futures price. For a put, the intrinsic value is the amount that the strike price exceeds the futures price. For a call, the intrinsic value is the amount that the strike price is below the futures price. If the strike price for a put is below the futures, the intrinsic value is zero, not negative. Similarly, a call with a strike price above the futures has no intrinsic value, but is not considered negative.

Options are said to be "in-the-money" if they have intrinsic value and "out-of-the-money" if they have no intrinsic value. If the strike price equals the futures price, puts and calls are "at-the-money."

Premiums, of course, are affected by the intrinsic value, and also the length of time to expiration of the option. This latter element is called "time value." Time value originates from the fact that the longer the time until expiration, the more opportunity for buyers and sellers to profit--therefore, the premium will reflect more than just the intrinsic value. Time value decreases with the length of time until expiration.

The more volatile the market, the more opportunity for profit. Therefore, option premiums are positively correlated with the amplitude of futures price swings. To a minor extent, interest rates are negatively related to option premiums. This is because option buyers must deposit the premiums and sellers must maintain margin accounts.

The maximum loss for option buyers is the premium plus brokerage costs. The potential loss for an option seller is unlimited except that a seller of puts has a lower bound on losses at a futures price of zero.

The expiration date for options is about one month ahead of the expiration on the underlying futures. If buyers (holders) of options elect to exercise those options, they are assigned a position in the futures market. A buyer of a put would be assigned a short position in the respective futures. A buyer of a call would be assigned a long position.[1] As with futures, most holders of options elect to offset (sell their options before expiration).

For farmers and commercial operators in the commodity business, looking for a way to reduce price risks, options offer a means to establish a minimum price on a product for sale or a maximum price on an input to be bought--plus some other more exotic pricing possibilities. This forward pricing mechanism will be discussed in Chapter 3.

[1]At the CBT, sellers of options are drawn at random to take the opposite position in futures to the buyer when the buyer decides to exercise.

How Options Prices are Quoted

Like futures, options premiums are quoted widely in the media. Only the settle or closing premiums are quoted because space limitations preclude much more detail. As an example, Table 2.2 presents the quotes for July 1996 and December 1996 corn options. Options are traded for the other futures months as well--March and May and September.

The strike price on July options ranged from 370 cents ($3.70) to 480 cents ($4.80) per bushel in 10 cent increments. On December 1996 corn options, strike prices ranged from 290 to 400 cents per bushel. Total volume in number of contracts daily for all corn options and total open interest for puts and calls were also listed.

Following is an illustration of how the intrinsic and time values are determined. On the same day, December corn futures closed at 333 cents per bushel (Table 2.1). The intrinsic value of a December corn put with a strike price of 350 cents at that time was 17 cents (350-333). The premium was 43 cents. The difference between the 43 and 17 cents represents the time value of 26 cents. This contract would be considered "in the money."

The December corn put with a strike price of 300 settled at a premium of 16 cents on that day. This put option, which carries the right to sell December corn futures at 300, is "out-of-the-money" with the market price at 333. All of the 16 cents premium is time value.

On the other hand, the December call with a strike of 300 cents is "in-the-money" because it conveys the right to buy at a price below the market. The intrinsic value is 33 cents (333 - 300). The time value is 15 cents calculated by subtracting the 33 cents from the 48 cent premium. The 350 strike December call is "out-of-the-money" with the entire 27 cent premium as time value.

Profit Patterns Diagrammed

To gain a clearer understanding of the option market, a comparison with the futures market may be helpful. The top section of Figure 2.1 is a simple diagram on how a change in

Table 2.2

Closing Quotations on Selected Corn Options at the Chicago Board of Trade, 5,000 Bushel Contracts in Cents per Bushel, April 24, 1996[a]

Contract Month

July 1996[b]			December 1996[c]		
Strike Price	Puts	Calls	Strike Price	Puts	Calls
370	1	100	290	12	54
380	1	90	300	16	48
390	2	81	310	20	42
400	3	72	320	26	38
410	4	64	330	32	34
420	6	55	340	37	30
430	9	48	350	43	27
440	13	43	360	50	24
450	16	36	370	58	22
460	22	31	380	65	20
470	26	26	390	73	17
480	--	22	400	81	16

Total for all corn options: Volume = 22,564 calls, 24,094 puts
Open interest = 221,695 calls, 234,961 puts

[a]Option premiums are rounded to nearest whole number.
[b]Settle price on July 1996 futures was 470 cents.
[c]Settle price on December 1996 futures was 333 cents.

prices affects profits of long and short speculators in futures. Profits of longs are directly related to changes in futures prices; profits of shorts are inversely related. The charts on options in Figure 2.1 plot the relationship between a change in futures after a position has been taken in the option market and subsequent profits at expiration.How changes in prices of the underlying futures affect buyers and sellers of puts is shown in the two charts in the center section of Figure 2.1. The buyer of a put has purchased the opportunity (but not the obligation) to sell the underlying futures at a given strike price. If prices on the underlying futures decline, the right to sell at a given strike price becomes more valuable. If the additional value at expiration exceeds the time value paid by the buyer for that right (plus commissions), a profit is realized.

On the other hand, if prices on the underlying futures increase, the intrinsic value declines, eventually to zero. Also, the time value converges to zero as the expiration date approaches. This establishes the maximum loss for a buyer of puts--the entire premium (plus commissions). In a sense, a buyer of puts has no upper bound on profits, but a lower bound on losses.

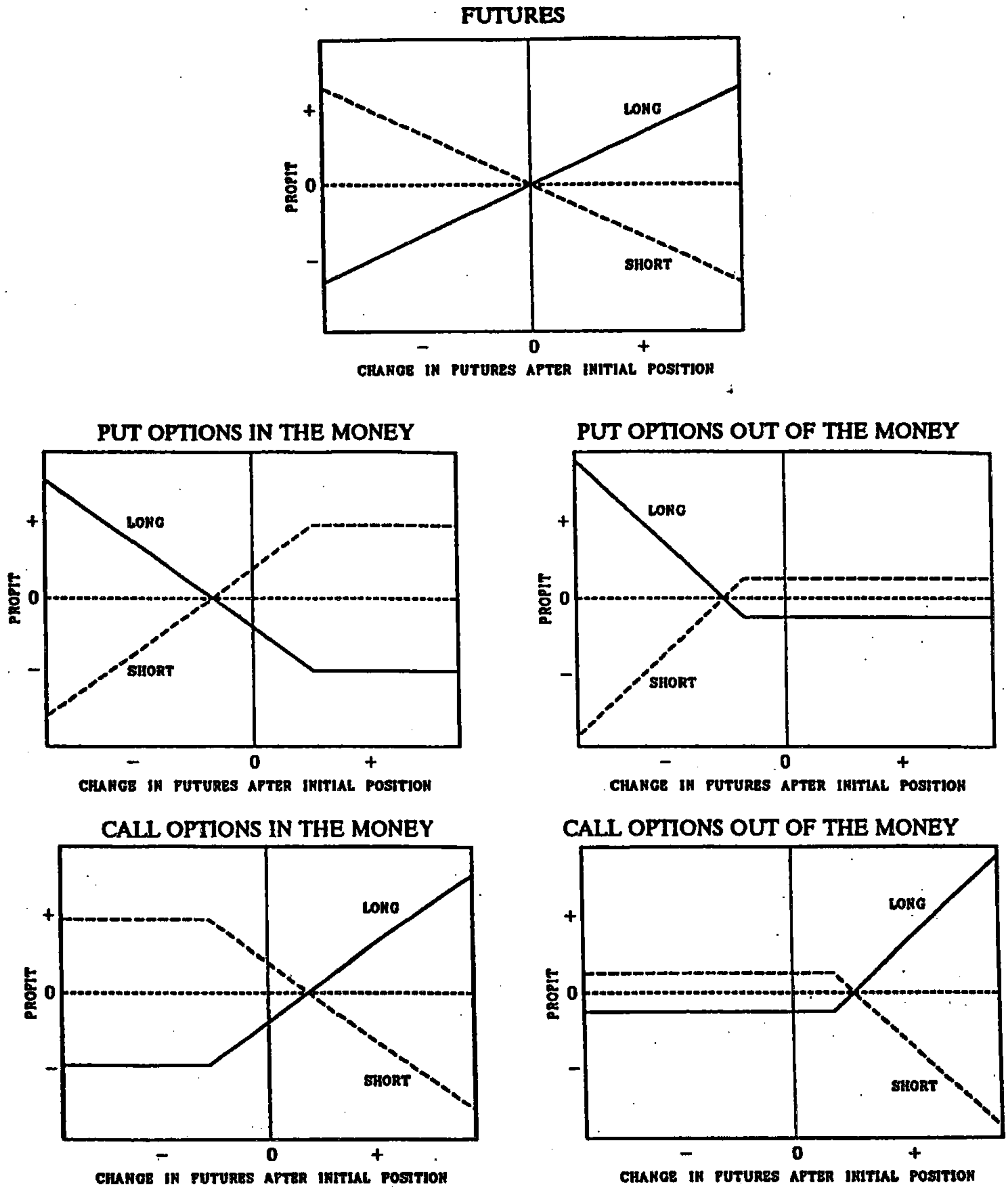
In contrast, a seller of puts has an upper bound on profits with losses virtually unlimited except in the unlikely event that the price on the underlying futures drops to zero. If the prices on the underlying futures rise, the seller pockets the premium--the maximum return (less commissions and interest on a margin account).

Note in Figure 2.1 that if prices on the underlying futures do not change, the seller of puts gains and the buyer loses. Essentially, the buyer pays the seller the time value of the option, since the intrinsic value does not change.

For buyers (longs) of put options in the money, a decline in futures immediately increases the intrinsic value. By expiration, if the increase in intrinsic value exceeds the original time value, the buyer profits. If futures increase, intrinsic value immediately declines. When futures

Figure 2.1

Effects of Changes in Futures Prices on Profits of Speculators in Futures and Options (by Expiration)[a]



[a]Excluding commissions and interest on margin account.

rise to and above the strike price, the intrinsic value becomes zero and at expiration, the buyer of the put would incur losses equal to the original premium (intrinsic value, plus time value, plus commissions). However, no matter how much futures increase, the maximum loss is the original premium, plus commissions.

The sellers (shorts) of puts in the money would incur losses if futures decline more than the time value on the option. As can be noted in Figure 2.1, the losses are unbounded and the profits have an upper bound equal to the original premium on the option (less commissions and interest on the margin account).

Similar relationships are evident in the chart on puts out of the money. The buyer of an out-of-the-money put is risking less on the premium than with in-the-money puts, but usually must count on a greater drop in price before the put has intrinsic value and the premium on the put begins to increase. The seller of the put has a wide range of prices that will provide a profit. Even with some decline in futures, the seller's maximum profit remains intact.

In the bottom section of Figure 2.1 is diagrammed the effects of changes in the price of the underlying futures on profits of buyers and sellers of calls. The buyer of a call purchases the right to buy the underlying futures at a specific strike price. When the price of the underlying futures rises, this right becomes more valuable. By expiration, if the intrinsic value has increased enough to exceed the original time value paid by the buyer, a profit is realized. A decline in the price of the underlying futures reduces the value of that right and eventually renders it worthless as time value evaporates. The maximum loss is the original premium (plus commissions).

The seller of the call faces the opposite pattern. A rise in price eventually results in declines in the premium that exceeds the original premium received by the seller for underwriting the call, and losses accumulate with further increases in futures prices. A drop in futures to or below the strike price renders the call worthless at expiration, providing the seller with a profit equal to the original premium. This premium is the maximum profit for the seller of calls (less commission and interest on margins).

As with puts, the buyer of a call faces no upper bound on profits, but has lower bound on losses. The seller has an upper limit on profits, but no bound on losses. With no or little price change on the underlying futures, the seller profits and the buyer loses.

The futures-profit relationships on calls, shown in the two charts at the bottom of Figure 2.1, are essentially mirror images of the puts. With in-the-money calls, the intrinsic value (and premium) would be directly related to futures over a range of prices. At expiration, if futures had declined to the strike price or lower, the buyer's losses would be capped at the premium paid and the seller's gains would be at their upper limit.

For call options out-of-the-money, risks for buyers and profit opportunities for sellers would be less than for in-the-money calls. Buyers would have to count on futures reaching and exceeding the strike price before profits would be realized.

Pricing Options

As mentioned earlier, the premium on an option is directly related to: (1) the intrinsic value, (2) time to expiration, and (3) volatility of the market, and inversely related to (4) interest rates. Given this information, formulas have been developed to determine the value of options at given points in time, indicative of what the premiums should be. If the premium differs from the calculated value, arbitrage should bring the premium into line, unless, of course, traders perceive that the expected volatility differs from that measured by the formula.

Best known among these formulas is the Black/Scholes option pricing model (Chance, 1991). This model applies to European options on non-divided-paying stocks. A difference between European and American options is that European options cannot be exercised before expiration.

In 1976, Black developed a variant of the option pricing formula to specifically value options on futures contracts (Chicago Board of Trade, 1987). This model is defined as follows:

$$VLCL = e^{-IT} * [FTP * N(d_1) - STP * N(d_2)]$$

$$VLPT = -e^{-IT} * [FTP * N(-d_1) - STP * N(-d_2)]$$

where: $d_1 = [\ln(FTP/STP) + SD^2 * T * .5]/(SD * \sqrt{T})$

$d_2 = d_1 - (SD * \sqrt{T})$

VLCL = value of the call

VLPT = value of the put

FTP = price of the underlying futures

STP = strike price

T = time to expiration in terms of proportion of a year

I = short-term annual interest rate on low risk securities

SD = historical annualized standard deviation of the daily percentage change in the price of the underlying futures

$N(d_1)$, $N(d_2)$ = cumulative normal probability values of d_1 and d_2, respectively

The application of the formula may be clearer in the following example with value for December 1993 corn futures and options on February 17, 1993:

FTP = $2.40 per bushel

STP = $2.50 per bushel

T = .75 (from February 17 to expiration in November is three-fourths of a year)

I = .031 (U.S. Treasury Bill's rate of 3.1 percent)

Assume that:

SD = .20 (historical annualized standard deviation of the daily percent change in FTP = 20 percent)

Calculations:

$$d_1 = [\ln(2.40/2.50) + (.20)^2 * .75 * .5]/(.20 * \sqrt{.75})$$

$$= [-.040822 + .04 * .75 * .5]/(.20 * .866025)$$

$$= [-.040822 + .015]/.1732$$

$$= -.025822/.17325 = -.149$$

$$d_2 = -.14909 - .20 * \sqrt{.75}$$

$$= -.14909 - .17325 = -.322$$

$$N(d_1) = N(-.149) = .441$$

$$N(d_2) = N(-.322) = .374$$

$$VLCL = e^{-.031 * .75} * [2.40 * .441 - 2.50 * .374]$$

$$= .977 * [1.0584 - .9350]$$

$$= .977 * .1234 = .12058 \sim 12¢ \text{ per bushel}$$

$$VLPT = -.977 * [2.40 * .559 - 2.50 * .626]$$

$$= -.977 * [1.3416 - 1.565]$$

$$= -.977 * [-.2234] = .21826 \sim 22¢ \text{ per bushel}$$

On the call:

Intrinsic value = 0¢ per bushel

Time value = 12¢ per bushel

On the put:

Intrinsic value = 10¢ per bushel

Time value = 12¢ per bushel

These values were very close to the actual premiums on February 17, indicating that the assumed SD of .20 was in line with expectations for volatility at that time.

In his evaluation of pre-harvest corn futures and marketing strategies in Iowa and Nebraska, Robert Wisner applied the Black Model and historical volatility in calculating premiums for years in which actual options trading did not exist (Wisner, 1991). He concluded that, based on the correlation between synthetic and actual premiums for the years, 1985-88, the application of synthetically derived premiums for 1979-84 was warranted for evaluating forward pricing schemes over that period. That is, "synthetic premiums for the 1979-84 crop years are a good representation of market premiums that would have occurred if actual trading had existed..."

The most difficult estimate to enter into the Black formulas is expected volatility. As was incorporated by Wisner, volatility is based on historical evidence. Yet, on commodities like corn and soybeans, rather than converting daily price changes in recent weeks to a computation of expected volatility for the growing season, more relevant would be the patterns for this season in recent years. This is because volatility generally increases as weather becomes more of a factor in May to October. Myers and Hanson have demonstrated that a GARCH option pricing model can address the problem of time-varying volatility and out-perform the standard Black Model (Myers and Hanson, 1993).

As can be discerned in the example on December corn options, another application of the Black formulas is to calculate the expected volatility implied by the current actual premiums. This, in a sense, works the formulas backwards. Rather than incorporating an estimate of expected volatility to determine whether the market is over- or under-estimating what the premium should be, the supposition is that the market is correct and the premium can be used to estimate the impending volatility. If the market is correct, such information has implications to commercial operators about forthcoming price variability and their need for price protection.

The Black formulas provide the means to calculate a relationship called "delta." Delta relates the change in the option premium to the change in the price of the underlying futures contract. The delta formulas are as follows:

$$\text{DLTCL} = e^{-IT} * N(d_1)$$

$$\text{DLTPT} = -e^{-IT} * N(d_1)$$

where: DLTCL = delta for a call

DLTPT = delta for a put

In the example for calculating the premiums for calls and puts on December corn futures and options on February 17:

$$\text{DLTCL} = e^{-.031 * .75} * .441$$

$$= .977 * .441 = .431$$

$$\text{DLTPT} = -e^{-.031 * .75} * .559$$

$$= -.977 * .559 = -.546$$

These delta figures also indicate "hedge ratios" for options. Both being relatively close to $|.5|$, approximately two calls or puts are necessary to offset one futures contract. If either the call or put are "deep in the money," the intrinsic value will be highly correlated to changes in the price of the underlying futures and will provide closer to one-to-one coverage in hedging. Also, for speculators, buying or selling "deep-in-the-money" options is more risky than trading cheaper options. Premiums for the expensive options will be more sensitive to rises and falls in prices of the underlying futures--providing more opportunity for profits, but also subjecting the trader to more exposure for losses.

Glossary

At the Money	Situation where the relevant futures price is equal to the strike price.
Basis	The difference between the price for a given futures contract and the cash price for a commodity at a given location, i.e., the difference between futures and cash prices. This may be expressed as "futures minus cash" or "cash minus futures," but preferably "cash minus futures."
Basis Risk	The deviation of basis at the conclusion of a hedge from what was expected at the beginning of a hedge.
Bearish (Bear)	Attitude or market condition pointing to lower prices. A person who expects prices to decline is a "bear."
Black or Black/ Scholes Formula	Formulas used to calculate the value of options, given the price of the underlying futures, the strike price, time to expiration, volatility and interest rates on safe securities.
Brokerage Cost	Commission charges for trading futures plus interest paid or foregone for maintaining margins at a brokerage establishment.
Bullish (Bull)	Attitude or market condition pointing to higher prices. A person who expects prices to increase is a "bull."
Calls	Options which confer the right, but not the obligation, to buy a futures contract at a stated price (strike) during a specified time period.
Cash Market Price	The current (or forward contract) price relating to a physical commodity at a specified location and time and with specified terms of sale. This could be net at the farm or at an elevator, local livestock market, a terminal market, etc.
Cash Settlement	On feeder cattle futures at the Chicago Mercantile Exchange and on milk futures at the Coffee, Sugar and Cocoa Exchange, an alternative to delivery is a settlement procedure with prices based on representative cash prices rather than futures.
Commercial House, Commercials, Commercial Operators	Firms with title to the cash product such as storage operators, processors, exporters, wholesalers, retailers, etc. Farmers would be considered as commercials.
Delivery Month	Month in which the physical commodity could be delivered at specified locations to fulfill the relevant futures contract. The period is usually the first three weeks of the month.
Delta	The ratio of change in an option premium relative to a change in the price of the underlying futures.

Exercising an Option	Making use of the right conveyed by an option. Buyer of a put would be assigned a short (sell) position in the relevant futures. Buyer of a call would be assigned a long (buy) position.
Exercise Price	Same as strike price.
Expected Basis	The basis anticipated at the time a hedge is placed <u>for the time the hedge is concluded</u>. Historical patterns are normally reviewed in order to make this forecast.
Expiration of an Option	The date at which the option buyer loses the right to exercise the option. This is about one month prior to the final delivery date of the respective futures.
Fence	Position for a long in the cash commodity achieved by buying put options "near the money" and selling calls one strike price above the current futures. This places both a lower bound and an upper bound on the net price received.
Forward Contract	An agreement between buyers and sellers of the physical (cash) commodity for the delivery of the product at some future period at a specific price with considerations on quality and other terms of sale.
Forward Pricing	The process of establishing price levels or certain price assurances in advance of cash sales (or purchases). This may involve forward contracting, hedging, use of options or combinations of these and other tools.
Futures Contracts	Legally binding commitments to deliver or take delivery of a given quantity and quality of a commodity, at a price agreed upon when the contract is made, with delivery at the seller's prerogative sometime during the specified future delivery month.
Futures Markets	Facilities for trading futures regulated in the U.S. by a government agency, the Commodity Futures Trading Commission. Both futures and options are traded in these markets. Best known among these markets are the Chicago Board of Trade and the Chicago Mercantile Exchange, both operations of the City of Chicago.
Government Loan	Guarantees which allow participants in government programs to establish floors on their prices. Loans are available at specified prices which farmers would elect to repay if market prices exceed the loan rate or deliver to the government if market prices do not rise enough above the loan rate to pay interest. (Interest is forgiven if farmers deliver.)
Hedging (Hedgers)	The process of establishing and maintaining a position in the futures market opposite to the position taken in the cash market. Those following this procedure are called hedgers. A hog producer who must buy corn could establish profit margins in advance by selling hog futures and buying corn futures. As cash corn is purchased,the corn futures would be sold. When the hogs are ready for sale, the hog futures would be purchased.

In the Money | Situation where on a put, the relevant futures price is below the strike price. On a call, the relevant futures price is above the strike price.

Intrinsic Value | On a put, the difference between the relevant futures price and the strike price when the futures price is below the strike; otherwise, the intrinsic value is zero. On a call, the difference between the relevant futures price and the strike price when the futures price is above the strike; otherwise, the intrinsic value is zero.

Long | A position in a cash futures market involving a commitment to later sell. A farmer planting soybeans is taking a long position in the cash soybean market. A speculator who buys soybean futures (excluding the situation where a speculator is offsetting a previously established short position) is taking a long position in soybean futures. This speculator must later sell soybean futures (or take delivery on soybeans which would put him/her in a long position in cash soybeans).

Margin | "Good faith" money which must be deposited with brokers in order to buy or sell futures. (Margin is also required of option sellers.) The requirements are generally less than 10 percent of the market value of the futures traded. Additional margin will be required if the equity in the account declines. Margin money may be withdrawn if the equity increases. Margin requirements for hedgers are less than for speculators.

Margin Call | Communications from brokers indicating that additional margin money is required to maintain the established position in the futures markets. Such margin must be furnished quickly or the position will be closed out.

Maximum Buying Price | The expected maximum price the buyer of a cash input could establish by buying calls. The actual maximum is determined by what basis turns out to be. Alternatively, basis risk could be eliminated by simultaneously forward contracting the input and buying puts.

Minimum Price Contracts | Forward contracts offered by buyers which establish a price floor for a seller of the cash product.

Minimum Selling Price | The expected minimum price the seller of a cash product could establish by buying puts. The actual minimum is determined by what basis turns out to be. Alternatively, basis risk could be eliminated by simultaneously forward contracting the product and buying calls.

Offset | Liquidation of a position in the futures or option markets prior to expiration. In futures, this means buying having previously sold or selling having previously bought. In options, buyers of puts or calls would sell prior to expiration and would not exercise.

Open Interest	Number of contracts which must be either offset or deliveries made and taken, measured as the number of contracts long or short, not the sum of the two.
Option Buyer	A person who obtains the rights conveyed by the option.
Option Contract	Rights to buy or sell futures contracts at a stated price (strike) during a specified time period.
Option Premium	The price of an option contract.
Option Seller (Writer)	A person who sells the rights conveyed by the option.
Out of the Money	Situation where, on a put, the relevant futures price is <u>above</u> the strike price. On a call, the relevant futures price is <u>below</u> the strike price.
Puts	Options which confer the right, but not the obligation, to sell a futures contract at a stated price (strike) during a specified time period.
Short	A position in a cash or futures market involving a commitment to later buy. A hog producer who has not purchased needed soybean meal is short in the soybean meal cash market. A speculator who sells soybean meal futures (excluding the situation where a speculator is offsetting a previously established long position) is taking a short position in soybean meal futures. This speculator must later buy soybean meal futures (or deliver soybean meal which means he/she must buy cash soybean meal to fulfill the futures contract).
Speculating (Speculators)	The process of establishing positions in the cash, futures or options markets in order to profit from a favorable change in prices (premiums). Those engaged in this activity are called speculators. Speculators are traditionally viewed as individuals trading futures or options with no connection to the cash commodity. However, the largest group of speculators in agricultural commodities are farmers--speculating in the cash market. Most farmers have substantial commitments in product and input markets not covered by forward pricing.
Strike Price	The price at which the option can be exercised and a position established in the futures market. Strike prices are set by the administration of the futures markets.
Synthetic Put	The combination of selling futures and buying calls with a strike price closest to the underlying futures.
Time Value	The amount by which an option's premium exceeds its intrinsic value. The time value is directly related to the amount of time remaining until expiration. The longer the time until expiration, the greater the

probability of a profitable move for the buyer. If an option has no intrinsic value, its premium is entirely time value.

Volatility — Variance in prices. For option pricing, volatility has been defined as the annualized standard deviation of the daily percentage change in the price of the underlying futures.

Volume in Futures and Options — Number of contracts traded in a given business day.

Notes

Notes

CHAPTER 3
FORWARD PRICING WITH FUTURES AND OPTIONS

Commodity futures and options provide commercial operators, farmers included, with a wide array of forward pricing alternatives. Positions (long or short) in the cash market can be combined with positions in futures and options to allow decision makers to establish forward price possibilities in line with their financial ability and inclination to handle risk. These alternatives will be discussed in terms of both selling a cash product and buying a cash product or raw material. First to be covered is selling a cash product.

Selling a Cash Product

The term hedging applies to action in the futures market appropriate for forward pricing the cash product. The essence of hedging is to have an opposite position in the futures market as in the cash market. If you have a long position in the cash product, you need to have an equal and opposite (or short) position in the futures market to be fully hedged.

Since prices on a given product in a cash market tend to move in parallel fashion with the futures on that product, a loss in the cash market means a gain in futures and vice versa. As a textbook example, a farmer harvesting corn in October is essentially taking a long position in the corn market. To hedge, this farmer would sell futures, which means going short in the futures market. Later, when the farmer decided to sell the corn, if cash prices had dropped 20 cents per bushel, this loss would tend to be offset by a similar profit in futures. The farmer could buy back the futures about 20 cents less than the selling price. This example, of course, excludes storage and brokerage costs.

On the other hand, if the cash market had increased 20 cents per bushel, this profit would tend to be offset by a similar rise in futures. The farmer would have to buy back the futures sold at a price about 20 cents higher than the price at which the futures had been sold--again ignoring storage and brokerage costs. The point is that hedging allows the farmer to set an approximate forward price, with protection from potential loss in the cash market, but also with negation of the potential profits from a rise in cash prices.

While this example would appear to be a rather sterile "no-loss, no-gain" forward pricing action, profits are to be made in hedging. The key to effective hedging is being able to predict the "basis." As defined in the Glossary to Chapter 2, "basis" is the difference between the price for a given futures contract and the cash price for a commodity at a given location. The preferred formula for basis is:

Basis = Cash Price - Futures Price[1]

Simple Storage Hedge

To illustrate a fairly simple hedge and introduce basis considerations, along with storage and brokerage costs, Table 3.1 outlines how forward pricing decisions might have been made under two situations. The storage operator buys cash soybeans on January 15 at $5.60 per bushel. To hedge, this individual selects July as the appropriate contract to use in a storage hedge. Presumably, July futures prices were enough above the interim contracts (March and May) to pay for storage into July. The action taken was to sell July soybean futures.

Assume that on June 15, the storage operator elected to sell the cash soybeans at the local market price of $5.00. To "lift" the hedge on that day, this individual called a broker and initiated a buy order on July soybeans which was $5.18 per bushel.

Looking at the cash side of Table 3.1, it is apparent that the operator lost 60 cents in the market drop from $5.60 to $5.00. In addition, the cost of storage of 30 cents per bushel brought the total loss to 90 cents per bushel. On the futures side, buying back the July contract at $1.02 less than the sale price netted $1.00 after a brokerage cost of two cents was deducted.

[1]Alternatively the formula could be: Basis = Futures Price - Cash Price. While somewhat arbitrary, reasons can be given for adopting the preferred formulation.

Table 3.1

Results from Hedging Soybeans in Storage

PRICES DECLINE

Date/Item	Cash Action	Cash $/bu.	July Futures Action	July Futures $/bu.
1/15	Buy	5.60	Sell	6.20
6/15	Sell	5.00	Buy	5.18
Difference		-.60		+1.02
Brokerage				-.02
Storage costs		-.30		
Cash net		-.90		
Futures net		+1.00		+1.00
Hedge net		+.10		
Net price received		5.70		

PRICES RISE

Date/Item	Cash Action	Cash $/bu.	July Futures Action	July Futures $/bu.
1/15	Buy	5.60	Sell	6.20
6/15	Sell	7.00	Buy	7.18
Difference		+1.40		-.98
Brokerage				-.02
Storage costs		-.30		
Cash net		+1.10		
Futures net		-1.00		-1.00
Hedge net		+.10		
Net price received		5.70		

The gain from futures more than offset the loss in the cash market, and the storage operator posted a 10 cent profit. Adding 10 cents to the initial buying price of $5.60 meant the final net price for the soybeans amounted to $5.70 per bushel.

Alternatively, assume that prices rose between January and June as illustrated in the bottom section of Table 3.1. On June 15, the storage operator sold cash soybeans for $7.00 for a nice gain of $1.40 which left $1.10 after storage costs were deducted. On the futures side of the ledger, buying July futures at a much higher price left a loss of $1.00 after brokerage costs were deducted. A $1.10 net gain from the cash side less the $1.00 loss on futures left the storage operator in the same position as when prices fell. The net from the hedge was +10 cents per bushel, resulting in an identical net price received of $5.70 per bushel.

Note that in both examples the basis on June 15 was -18 cents ($5.00-5.18). That is a special case and not often observed, but assumed here for purposes of exposition.

Similar examples are presented in Table 3.2. The only difference is that a set of two columns is added on basis, and basis risk is introduced. In these cases, the storage operator evaluates his/her opportunities for profit on January 15 by a careful inspection of basis.

The numbers in italics are generally known or expected at the time the decision is made. The current cash and futures prices are easily obtained. Storage and brokerage costs are reasonably predictable. A major exception might be the interest on margin money required if prices rise--but this is not a major cost item over a five-month period. The expected basis of -20 cents per bushel in June is derived from records of past years and some judgment about possible departures from the past. Because basis does vary from year-to-year, this is only an estimate, but it does convey very important information to the storage operator.

The expected basis column of Table 3.2 can be filled out in advance of making the storage decision. The storage operator looks at the current (January 15) basis of -60 cents per bushel and compares this with his/her best estimate of what basis will be in mid June, which is

Table 3.2

Expectations and Results from Hedging Soybeans in Storage

PRICES DECLINE

Date/Item	Cash Action	Cash $/bu.	July Futures Action	July Futures $/bu.	Basis Expected[a/] $/bu.	Basis Actual $/bu.
1/15	Buy	*5.60*	Sell	*6.20*	X	*-.60*
6/15	Sell	5.00	Buy	5.18	*-.20*	-.18
Difference		-.60		+1.02	*+.40* [b/]	+.42 [c/]
Brokerage				-.02	*-.02*	-.02
Storage costs		-.30			*-.30*	-.30
Cash net		-.90				
Futures net		+1.00		+1.00		
Hedge net		+.10			*+.08*	+.10
Net price: Expected		*5.68*				
Received		5.70				+.02

PRICES RISE

Date/Item	Cash Action	Cash $/bu.	July Futures Action	July Futures $/bu.	Basis Expected[a/] $/bu.	Basis Actual $/bu.
1/15	Buy	*5.60*	Sell	*6.20*	X	*-.60*
6/15	Sell	7.00	Buy	7.23	*-.20*	-.23
Difference		+1.40		-1.03	*+.40* [b/]	+.37 [c/]
Brokerage				-.02	*-.02*	-.02
Storage costs		-.30			*-.30*	-.30
Cash net		+1.10				
Futures net		-1.05		-1.05		
Hedge net		+.05			*+.08*	+.05
Net price: Expected		*5.68*				
Received		5.65				-.03

[a/] This column to be filled out in advance of the hedge to determine likely profitability. Likely profitability (hedge net in expected basis column), in combination with buy price (cash column), determines net price expected (cash column).
[b/] Expected basis for the end of the hedge minus actual basis at the beginning of the hedge.
[c/] Actual basis at the end of the hedge minus actual basis at the beginning of the hedge.

-20 cents. The difference is +40 cents (-20 cents - (- 60 cents) = +40 cents). In the terminology of the trade, the basis is expected to strengthen by 40 cents per bushel. The next question is, "Will the strengthening of basis of +40 cents be enough to cover storage costs of 30 cents and pay the broker two cents?" The answer is "yes" and this would also point to a net return of eight cents from the hedge.

In the case of a price decline, the net from the hedge of 10 cents turned out to be two cents more than expected. This can quickly be confirmed by the fact that basis was -18 cents on June 15, two cents stronger than expected.

The case of a price rise was slightly modified from Table 3.1. In this case, the basis turned out to be three cents weaker than expected, with the cash market 23 cents per bushel under July futures on June 15. This resulted in a net from the hedge of five cents, three cents less than projected.

The important consideration is that the net returns from the two cases ranged from 10 cents to five cents, compared to an unhedged position in which the net would have ranged from a $.90 loss to a $1.10 per bushel gain. The storage operator avoided possible bankruptcy if prices had declined, but of course, was deprived of a large windfall in the cash market had prices risen. Not knowing which way the prices might go after January 15, the operator made the correct decision by hedging.

Another major point is, that once fully hedged, the storage operator does not care whether the cash and futures markets go up or down. The only concern is what happens to the difference, i.e., the basis. The entire story is told in the final two columns of Table 3.2--what was expected in advance and what finally materialized. Commercial houses focus on the basis and bet their skills on forecasting that relationship rather than movements in the level of price.

In Table 3.2, if the projected change in basis was +25 cents per bushel rather than +40 cents per bushel, the change would not have covered the cost of storage and brokerage. The message to the storage operator would have been not to buy cash soybeans. Or if a farmer happened to own cash soybeans on January 15, the message would have been: (1) sell the soybeans or (2) continue to store and take a chance on a price rise (if the risk can be handled). But, in any case, don't hedge. If you did hedge, chances are you would lock in a loss relative to selling on January 15.

Storing Soybeans and Buying Puts

Extending this example to one where the storage operator was considering buying soybeans and covering that position with long puts, the expectations and results are shown in Table 3.3. The beginning situation is the same as in Table 3.2 with the cash price of $5.60 and July futures at $6.20. Assume that on January 15, July soybean puts, with a strike price of $6.50, were trading at a 55 cent premium. By inspection, this means that the time value is 25 cents since the intrinsic value is 30 cents per bushel.

The downside risk can be calculated in advance as shown in the right-hand column. The put provides the right to sell July futures at $6.50. Subtracting: (1) the premium which could be as low as zero at expiration, (2) the expected basis since the storage operator will sell cash soybeans locally, (3) brokerage costs and (4) storage costs, gives an expected minimum cash price of $5.43. This is well below the current price and the expected net price from hedging of $5.68 as given in Table 3.2. The storer could rationalize buying puts over hedging if he/she: (1) could handle the risk of a possible 17 cent per bushel loss (relative to not buying soybeans on January 15), emotionally and financially, (2) did need some downside price protection and (3) had strong convictions that market prices would increase substantially.

If cash prices did drop sharply as in the top section of Table 3.3, the put would become more valuable and could be sold at a profit in mid June. However, the storer had to pay the seller of the puts 24 cents in time value and the 78 cent profit on the puts was not enough to offset the 90 cent loss in the cash side of the ledger. The net loss from the combination of

Table 3.3

Expectations and Results from Storing Soybeans and Buying July Soybean Puts with a $6.50 Strike Price

PRICES DECLINE

Date/Item	Cash Action	Cash $/bu.	July Futures $/bu.	July $6.50 Puts Action	July $6.50 Puts Premium	Net Minimum Price Expected[a] $/bu.
Strike Price						6.50
1/15	Buy	5.60	6.20	Buy	.55	-.55
6/15	Sell	5.00	5.18	Sell	1.33 [b]	0 [c]
Difference		-.60	-1.02		+.78	-.55
Expected Basis						-.20
Brokerage					-.02	-.02
Storage Costs		-.30				-.30
Cash Net		-.90				
Options Net		+.76			+.76	
Combination Net		-.14				
Net price: Minimum Expected		5.43				5.43 [d]
Received		5.46				

PRICES RISE

Date/Item	Cash Action	Cash $/bu.	July Futures $/bu.	July $6.50 Puts Action	July $6.50 Puts Premium	Net Minimum Price Expected[a] $/bu.
Strike Price						6.50
1/15	Buy	5.60	6.20	Buy	.55	-.55
6/15	Sell	7.00	7.23	Sell	.01 [b]	0 [c]
Difference		+1.40	+1.03		-.54	-.55
Expected Basis						-.20
Brokerage					-.02	-.02
Storage Costs		-.30				-.30
Cash Net		+1.10				
Options Net		-.56			-.56	
Combination Net		+.54				
Net price: Minimum Expected		5.43				5.43 [d]
Received		6.14				

[a]This column to be filled out in advance of the hedge to determine net minimum price expected.
[b]Actual premium assuming time value = $.01.
[c]Expected premium assuming no intrinsic value and time value = $0.
[d]Strike price less the total of: (1) original option premium less time value when sold, i.e., line marked "Difference" above; (2) expected basis; (3) brokerage; and (4) storage.

storing soybeans and buying puts was 14 cents per bushel, leaving the net price received to be $5.46. However, the storer accepted the risk. Due to the basis being two cents stronger than anticipated and the put carrying a slight one cent time value in mid June, the net price received was three cents per bushel above the expected minimum.

On the other hand, if prices increased substantially as shown in the bottom section of Table 3.3, the advantage of buying puts over hedging is apparent. The option was nearly worthless on June 15 because July futures were well above the $6.50 strike price. The total loss on the puts amounted to 56 cents per bushel. However, the sharp rise in the cash price of $1.10 provided a net return of +54 cents for a net price received of $6.14 per bushel. This was 49 cents greater than the net price from the hedge depicted in Table 3.2.

Forward Pricing Alternatives for a New Crop

To illustrate the array of forward pricing opportunities available to farmers and to commercial operators who also have title to commodities, Tables 3.4-3.8 display five different situations and results in forward pricing new crop corn. With some modifications, very similar opportunities are available for covering stored crops and also for forward pricing livestock.

The initial situation is as follows. On May 1, the farmer calculated his/her variable or direct cost of production at $1.75 per bushel for the current crop year. In a sense, this represents the farmer's "long" position in the cash market even though the product will not be harvested for five to six months. But the farmer is long in the resources to produce the product--in land, labor and capital. The $1.75, of course, understates the total commitment since important fixed costs are omitted. But the decision to plant corn in any given year is determined by the relationship between expected prices and variable costs.

Weak Basis - Tables 3.4-3.6 portray a situation labeled as "weak basis." Usual first receivers of grain from farms, called country elevators, can offer farmers cash forward contracts because these elevators can, in turn, hedge their positions in futures. Their offerings relative to

Table 3.4

FORWARD PRICING ALTERNATIVES FOR NEW CROP CORN, ASSUMING A WEAK BASIS AND A DECLINE IN PRICE

Date	Cash Market		Futures		Put Options			Forward Contract and Buy Calls	
5/1	Production Cost (variable)	$ 1.75	December (Futures Month)	2.40 (Sell)	December (Futures Month)			December (Futures Month)	
	Forward Contract Price (1)	2.02	Less: Expected Basis[b]	-.30	Strike Price	2.40	2.60	Strike Price	2.30
	Basis Contract Relative to December (Futures Month)	-.38	Brokerage Costs[c]	-.02	Less: Option Premium	-.18 (Buy)	-.30 (Buy)	Forward Contract Price	2.02
	Net Government Loan Rate (2)[a]	1.46	Equals Net Price Expected From Hedge	2.08	Expected Basis[b]	-.30	-.30	Less: Option Premium	-.22
	Expected Harvest Price				Brokerage Costs[c]	-.02	-.02	Brokerage Costs[c]	-.02
	Optimistic	2.50							
	Average	2.00							
	Pessimistic	1.50			Equals Minimum Selling Price Expected	1.90	1.98	Equals Minimum Selling Price	1.78
11/1	Harvest Price (3)	1.40	December (Futures Month)	1.73 (Buy)	December (Futures Month)				
	Net Price From Basis Contract = Futures + Basis Contract (4)	1.35	Actual Basis[d]	-.33	Optimum Premium[e]	.67 (Sell)	.87 (Sell)		0 (Sell)
Net Price Received From Hedge and Options									
	Cash Price at Harvest			1.40		1.40	1.40	Forward Contract Price	2.02
Plus Net Returns From Futures and Options									
	Sell and Buy (Futures) or Buy and Sell (Options)		+.67		+.49		+.57	-.22	
	Less Brokerage Costs[c]		-.02		-.02		-.02	-.02	
	Equals Net Returns			+.65		+.47	+.55		-.24
Equals Net Price Received			(5)	2.05		1.87 (6)	1.95 (7)	(8)	1.78

[a]Government loan rate less storage costs to maturity.
[b]the expected value, at harvest, of the cash price less the given futures.
[c]commissions and interest on margins or premiums.
[d]the actual value, at harvest, of the cash price less the given futures.
[e]Assumes no time value.

Table 3.5

FORWARD PRICING ALTERNATIVES FOR NEW CROP CORN, ASSUMING A WEAK BASIS AND A RISE IN PRICE

Date	Cash Market		Futures		Put Options			Forward Contract and Buy Calls	
5/1	Production Cost (variable)	$ 1.75	December (Futures Month)	2.40 (Sell)	December (Futures Month)			December (Futures Month)	
	Forward Contract Price (1)	2.02			Strike Price	2.40	2.60	Strike Price	2.30
	Basis Contract Relative to December (Futures Month)	-.38	Less: Expected Basis[b]	-.30				Forward Contract Price	2.02
			Brokerage Costs[c]	-.02	Less: Option Premium	-.18 (Buy)	-.30 (Buy)		
	Net Government Loan Rate (2)[a]	1.46	Equals Net Price Expected From Hedge	2.08	Expected Basis[b]	-.30	-.30	Less: Option Premium	-.22
	Expected Harvest Price				Brokerage Costs[c]	-.02	-.02	Brokerage Costs[c]	-.02
	Optimistic	2.50							
	Average	2.00			Equals Minimum Selling Price Expected	1.90	1.98	Equals Minimum Selling Price	1.78
	Pessimistic	1.50							
11/1	Harvest Price (3)	3.00	December (Futures Month)	3.28 (Buy)	December (Futures Month)				
	Net Price From Basis Contract = Futures + Basis Contract (4)	2.90	Actual Basis[d]	-.28	Optimum Premium[e]	0 (Sell)	0 (Sell)		.98 (Sell)
Net Price Received From Hedge and Options									
Cash Price at Harvest				3.00		3.00	3.00	Forward Contract Price	2.02
Plus Net Returns From Futures and Options									
Sell and Buy (Futures) or Buy and Sell (Options)			-.88		-.18		-.30	+.76	
Less Brokerage Costs[c]			-.02		-.02		-.02	-.02	
Equals Net Returns				-.90		-.20	-.32		+.74
Equals Net Price Received			(5)	2.10		2.80 (6)	2.68 (7)	(8)	2.76

[a]Government loan rate less storage costs to maturity.
[b]the expected value, at harvest, of the cash price less the given futures.
[c]commissions and interest on margins or premiums.
[d]the actual value, at harvest, of the cash price less the given futures.
[e]Assumes no time value.

Table 3.6

FORWARD PRICING ALTERNATIVES FOR NEW CROP CORN, ASSUMING A WEAK BASIS AND STABLE PRICES

Date	Cash Market		Futures		Put Options			Forward Contract and Buy Calls	
5/1	Production Cost (variable)	$ 1.75	December (Futures Month)	2.40 (Sell)	December (Futures Month)			December (Futures Month)	
	Forward Contract Price (1)	2.02							
	Basis Contract Relative to December (Futures Month)	-.38	Less: Expected Basis[b]	-.30	Strike Price	2.40	2.60	Strike Price	2.30
			Brokerage Costs[c]	-.02	Less: Option Premium	-.18 (Buy)	-.30 (Buy)	Forward Contract Price	2.02
	Net Government Loan Rate (2)[a]	1.46	Equals Net Price Expected From Hedge	2.08	Expected Basis[b]	-.30	-.30	Less: Option Premium	-.22
	Expected Harvest Price				Brokerage Costs[c]	-.02	-.02	Brokerage Costs[c]	-.02
	Optimistic	2.50			Equals Minimum Selling Price Expected	1.90	1.98	Equals Minimum Selling Price	1.78
	Average	2.00							
	Pessimistic	1.50							
11/1	Harvest Price (3)	2.10	December (Futures Month)	2.40 (Buy)	December (Futures Month)				
	Net Price From Basis Contract = Futures + Basis Contract (4)	2.02	Actual Basis[d]	-.30	Optimum Premium[e]	0 (Sell)	.20 (Sell)		.10 (Sell)
Net Price Received From Hedge and Options	Cash Price at Harvest			2.10		2.10	2.10	Forward Contract Price	2.02
Plus Net Returns From Futures and Options	Sell and Buy (Futures) or Buy and Sell (Options)		0		-.18		-.10	-.12	
	Less Brokerage Costs[c]		-.02		-.02		-.02	-.02	
	Equals Net Returns			-.02		-.20	-.12		-.14
Equals Net Price Received			(5)	2.08		1.90 (6)	1.98 (7)	(8)	1.88 (6)

[a]Government loan rate less storage costs to maturity.
[b]the expected value, at harvest, of the cash price less the given futures.
[c]commissions and interest on margins or premiums.
[d]the actual value, at harvest, of the cash price less the given futures.
[e]Assumes no time value.

Table 3.7

FORWARD PRICING ALTERNATIVES FOR NEW CROP CORN,
ASSUMING A STRONG BASIS AND A DECLINE IN PRICE

Date	Cash Market		Futures		Put Options			Forward Contract and Buy Calls	
5/1	Production Cost (variable)	$ 1.75	December (Futures Month)	2.40 (Sell)	December (Futures Month)			December (Futures Month)	
	Forward Contract Price (1)	2.20	Less:		Strike Price	2.40	2.60	Strike Price	2.30
	Basis Contract Relative to December (Futures Month)	-.20	Expected Basis[b]	-.30	Less: Option Premium	-.18 (Buy)	-.30 (Buy)	Forward Contract Price	2.20
			Brokerage Costs[c]	-.02					
	Net Government Loan Rate (2)[a]	1.46	Equals Net Price Expected From Hedge	2.08	Expected Basis[b]	-.30	-.30	Less: Option Premium	-.22
	Expected Harvest Price				Brokerage Costs[c]	-.02	-.02	Brokerage Costs[c]	-.02
	Optimistic	2.50			Equals Minimum Selling Price Expected	1.90	1.98	Equals Minimum Selling Price	1.96
	Average	2.00							
	Pessimistic	1.50							
11/1	Harvest Price (3)	1.40	December (Futures Month)	1.65 (Buy)	December (Futures Month)				
	Net Price From Basis Contract = Futures + Basis Contract (4)	1.45	Actual Basis[d]	-.25	Optimum Premium[e]	.75 (Sell)	.95 (Sell)		0 (Sell)
Net Price Received From Hedge and Options									
Cash Price at Harvest				1.40		1.40	1.40	Forward Contract Price	2.20
Plus Net Returns From Futures and Options									
Sell and Buy (Futures) or Buy and Sell (Options)			+.75		+.57		+.65	-.22	
Less Brokerage Costs[c]			-.02		-.02		-.02	-.02	
Equals Net Returns				+.73		+.55	+.63		-.24
Equals Net Price Received			(5)	2.13		1.95 (6)	2.03 (7)	(8)	1.96

[a]Government loan rate less storage costs to maturity.
[b]the expected value, at harvest, of the cash price less the given futures.
[c]commissions and interest on margins or premiums.
[d]the actual value, at harvest, of the cash price less the given futures.
[e]Assumes no time value.

Table 3.8

FORWARD PRICING ALTERNATIVES FOR NEW CROP CORN, ASSUMING A STRONG BASIS AND A RISE IN PRICE

Date	Cash Market		Futures		Put Options			Forward Contract and Buy Calls	
5/1	Production Cost (variable)	$ 1.75	December (Futures Month)	2.40 (Sell)	December (Futures Month)			December (Futures Month)	
	Forward Contract Price (1)	2.20	Less: Expected Basis[b]	-.30	Strike Price	2.40	2.60	Strike Price	2.30
	Basis Contract Relative to December (Futures Month)	-.20	Brokerage Costs[c]	-.02	Less: Option Premium	-.18 (Buy)	-.30 (Buy)	Forward Contract Price	2.20
	Net Government Loan Rate (2)[a]	1.46	Equals Net Price Expected From Hedge	2.08	Expected Basis[b]	-.30	-.30	Less: Option Premium	-.22
	Expected Harvest Price				Brokerage Costs[c]	-.02	-.02	Brokerage Costs[c]	-.02
	Optimistic	2.50							
	Average	2.00			Equals Minimum Selling Price Expected	1.90	1.98	Equals Minimum Selling Price	1.96
	Pessimistic	1.50							
11/1	Harvest Price (3)	3.00	December (Futures Month)	3.25 (Buy)	December (Futures Month)				
	Net Price From Basis Contract = Futures + Basis Contract (4)	3.05	Actual Basis[d]	-.25	Optimum Premium[e]	0 (Sell)	0 (Sell)		.95 (Sell)
Net Price Received From Hedge and Options	Cash Price at Harvest			3.00		3.00	3.00	Forward Contract Price	2.20
Plus Net Returns From Futures and Options	Sell and Buy (Futures) or Buy and Sell (Options)		-.85		-.18		-.30	+.73	
	Less Brokerage Costs[c]		-.02		-.02		-.02	-.02	
	Equals Net Returns			-.87		-.20	-.32		+.71
Equals Net Price Received			(5)	2.13		2.80 (6)	2.68 (7)	(8)	2.91

[a]Government loan rate less storage costs to maturity.
[b]the expected value, at harvest, of the cash price less the given futures.
[c]commissions and interest on margins or premiums.
[d]the actual value, at harvest, of the cash price less the given futures.
[e]Assumes no time value.

futures vary from time to time, sending signals to farmers about how anxious they might be to obtain the cash product. A "weak basis" means that this offering is low relative to futures. This may have implications to farmers on which forward pricing scheme to use.

The initial situations in Tables 3.4-3.6 are the same. On May 1, the farmer could forward contract with the elevator for $2.02 per bushel. This means that the elevator is obligated to pay the farmer $2.02 on a specified amount at harvest in October or November. On May 1, December futures (nearest futures after harvest) traded at $2.40. The forward contract, then, was 38 cents under December futures (a basis of -38 cents per bushel).

In addition to the cash forward contract of $2.02, elevators also offer "basis contracts." A basis contract is simply an agreement that the elevator will write a forward contract with the farmer at a specified amount relative to futures. The farmer determines the timing. In Tables 3.4-3.6, the basis contract was 38 cents below December futures on May 1. From historical information, the expected basis at harvest is -30 cents per bushel. This is why this example is labeled "weak basis."

Deducting expected basis and brokerage costs from December futures provides the net price expected from hedging of $2.08 per bushel. This figure is six cents above the forward contract and might persuade the farmer to hedge rather than enter a forward contract.

The alternative forward pricing schemes are to forward contract at $2.02, enter a basis contract at -38 cents relative to December futures, hedge with an expected net price of $2.08 or do nothing. Another consideration is the government support price or net government loan rate of $1.46 which would tend to put a lower bound on market returns. Also, the fundamental outlook might weigh on the farmer's decision, assumed here to range between $1.50 and $2.50 per bushel, with the average at $2.00. A pessimistic forecast would make farmers more inclined to take price protection.

Three other forward pricing alternatives are presented in Tables 3.4-3.6, two with put options and one with call options. The examples with purchasing December put options compare the results with two different strike prices, $2.40 and $2.60. Obviously the right to sell at $2.60 is more costly (30 cents) than the right to sell at $2.40 (18 cents). Deducting premiums, expected basis and brokerage costs from the strike prices, the $2.40 put sets an expected minimum price at $1.90 and the $2.60 put sets an expected minimum at $1.98.

At first glance, one might ask why buy the cheaper put which sets a lower minimum. The answer will be clearer when the results between a price fall and a price rise are examined.

Finally, one example is presented under the title "Forward Contract and Buy Calls." As the title indicates, this is a combination of a cash forward contract entered on May 1 and the purchase of a December call. Subtracting the option premium and brokerage costs from the forward contract price equals the minimum selling price of $1.78. There is no basis risk; that is, the forward contract of $2.02 is guaranteed regardless of what happens to futures. The most the farmer can lose from the call is 24 cents, which would be the case with a significant price decline.

So added to the forward pricing alternatives on May 1 discussed earlier, the farmer also can set lower bounds on prices without incurring an upper limit. While the forward contract and hedging point to higher established prices than turning to puts and calls, farmers who are optimistic about prices rising, but who require some price protection, have the tools to fit their risk preferences.

The weak basis, however, does convey information about which tools to use. Farmers would want to avoid locking in the basis which would happen with: (1) forward contracts, (2) basis contracts and (3) forward contracts and long calls. Choices among the other alternatives would depend upon the farmer's financial situation, aversion to risk and price expectations.

Table 3.4 portrays what might happen if prices decline significantly between May 1 and November 1. The numbers in the boxes represent the final results from eight forward pricing alternatives.

In Box 1 is the forward cash contract of $2.02 established on May 1. In Box 2 is the net government loan rate which was likely employed in this case since the harvest price (Box 3) was $1.40. The $1.40 represents the consequence of doing nothing. The return from the basis contract was $1.35 (Box 4), assuming the farmer held the contract until November 1. The calculations of the return is simply December futures on November 1 of $1.73 less the basis contract of -38 cents which equals $1.35. On both doing nothing and the basis contract, the farmer would have failed to cover variable costs.

Note in the futures column that basis turned out to be -33 cents on November 1, three cents weaker than expected. Buying back the December futures netted 67 cents less two cents brokerage for a profit of 65 cents to add to the cash price of $1.40 to give a net price received of $2.05 (Box 5). The weaker than expected basis resulted in a net price three cents less than anticipated on May 1, but still above the forward contract price.

With the sharp drop in futures prices, the puts became more valuable and protected the farmer from major downside losses in the cash market. (Assumed in these cases is that time value is nil and the final premium is equal to the intrinsic value.) The net price received under the two schemes at $1.87 (Box 6) and $1.95 (Box 7) were three cents less than expected minimums because basis was three cents weaker than expected.

The basis having been locked in, the minimum selling price realized with the forward contracting and purchase of calls was $1.78 (Box 8), below the net prices from the puts. As can be noted, the calls expired worthless leaving the net price at the minimum calculated on May 1.

The worst alternative was the basis contract (Box 4) followed by doing nothing (Box 3). Again, the basis contract locked in a weak basis; it is better to take chances on a favorable move in futures with no basis contracts. Among the options, the puts outperformed the forward contract and purchase of calls--again because the latter locked in a weak basis. Between the $2.40 and $2.60 puts, the advantage went to the more expensive option which set the higher expected minimum.

The top return was with the hedge at $2.05 (Box 5). Under the circumstances, hedging was a logical choice over a forward contract for reasons similar to buying puts--the weak basis on May 1 was not locked in.

In Table 3.5, the only differences from Table 3.4 is that: (1) prices rise substantially between May 1 and November 1, and (2) the basis turned out to be slightly stronger than expected on November 1. With the basis two cents stronger than expected, the net price received from the hedge (Box 5) was two cents above the expected level and eight cents above the forward contract (Box 1).

The most profitable alternative was to do nothing (Box 3) and second best was the basis contract (Box 4). Farmers with government non-recourse loans (Box 2) would have eventually sold corn on the market and repaid the loan. As could be anticipated, pricing tools which set minimums resulted in higher nets than forward contracting and hedging, but because of premiums and brokerage costs, did not match doing nothing or basis contracts.

The puts expired worthless, but the $2.40 put lost only 18 cents in the premium versus the 30 cents loss for the $2.60 put. For this reason, the net price received from the $2.40 put was 12 cents above the $2.60 put; that is, $2.80 (Box 6) compared with $2.68 (Box 7). Therein is the reason a farmer might logically choose a put which sets a lower minimum than a more expensive put. In the event of a price rise, the cheaper put will net a higher price.

The net price received from the forward contract and purchase of a $2.30 December call was $2.76 (Box 8), above the net from the $2.60 put, but still below the net from the $2.40 put. The $2.40 put was clearly the preferred alternative to the combination of a forward contract and purchase of the $2.30 call--netting higher returns in both eventual price declines and increases. The $2.40 put not only provided a higher minimum expected price, but also carried a lower premium than the $2.30 call.

For purposes of exposition, no time value was assumed on the options as of November 1. Since the expiration date on December options is late in November, some time value might remain on November 1, but would be small. Therefore, the option premiums on November 1 reflect intrinsic value, zero for the puts in Table 3.5 and 98 cents for the call.

In Table 3.6, the only differences from the previous two tables were: (1) futures prices did not change between May 1 and November 1, and (2) basis happened to turn out exactly as expected, -30 cents.

Because basis was as expected, the net prices from the hedge and purchases of puts were as expected. Also, the advantages were with these same alternatives which did not lock in the weak basis. The advantage of doing nothing over entering a basis contract can be noted.

The main point to be made in Table 3.6 is that <u>stable prices discriminate against options</u> as forward pricing tools. As stated in Chapter 2, in a stable market, the buyer of options pays the seller time value. So, as can be seen in Table 3.6, the net prices received from options were the lowest among all the alternatives (except the government loan which would not be relevant with market prices well above it).

In a sharply rising market, purchasers of put options gain from increases in the cash prices, and those locked into a forward contract with a long position in calls gain from increased premiums in calls. This beats forward contracting and hedging, but falls behind doing nothing or entering basis contracts.

In a sharply falling market, puts become more valuable and forward contractors who are long in calls are sustained by the forward contract. This position beats doing nothing or basis contracts, but loses out to forward contracting alone or hedging.

In other words, the forward pricing alternatives involving options are second best to other alternatives in case of sharply falling or rising prices and the least profitable with stable prices. This is not an argument against use of options, but emphasizes that they are most appropriate in situations of volatile prices in which farmers and other commercial operators perceive reasonable chances of a substantial rise in prices, but need some downside protection.

Strong Basis - Forward pricing situations covered in Tables 3.7 and 3.8 differ from Tables 3.4-3.6 in that, on May 1, cash contracting opportunities reflected a strong basis. The basis offered was 20 cents under December futures compared to the expected 30 cents under. Secondly, the actual basis on November 1 also turned out to be stronger than expected at 25 cents under.

In this case, the preferred alternatives on May 1 differed from those when the basis was weak. Forward contracting was clearly superior to a hedge. In essence, a forward contract locks in both futures and basis. Hedging only locks in futures. Hedgers face basis risk. For this reason, a guaranteed price of $2.20 is preferred over an expected price of $2.08 from a hedge. Only if basis turned out to be stronger than -17 cents on November 1, would hedging have netted higher returns than forward contracting.

For risk takers who do not require downside price protection and who expect prices to rise, a basis contract is preferable over doing nothing. These individuals are simply wagering that futures will increase more than their cash market--a reasonable bet considering historical basis data.

Those who need some downside price protection, but also believe prices will rise, would be advised to forward contract (locking in the favorable basis) and buy calls. This combination would tend to net higher prices than the alternatives of buying puts which lock in strike prices, but not basis.

The reader can follow the effects of significant price drops and rises in Tables 3.7 and 3.8. The results were as anticipated with the stronger performance by forward pricing techniques which had locked in the basis. One exception was the net price received from a $2.60 put in Table 3.7 (in the event of a price drop) exceeded that from forward contracting and buying calls. This can be traced to the potential to establish a somewhat higher minimum price ($1.98 versus $1.96) and the fact that basis turned out to be five cents stronger on November 1 than anticipated on May 1--although five cents weaker than could be locked in on May 1. With the price rise in Table 3.8, the advantage of forward contracting and buying calls is apparent.

Tables 3.4-3.8 apply to two specific points in time, May 1 (planting) and November 1 (harvest). Realistically, forward pricing decisions can be made well before May 1, between May 1 and November 1 and after November 1--whenever attractive opportunities are available. For example, a farmer might hedge corn in January well before planting, see forward contract prices decline to near the government loan rate by mid summer and lift the hedge, deciding downside risks on returns were minimal. At harvest, this farmer might see forward pricing opportunities on this same crop--indications that storage promised more profit than selling at harvest.

As can be discerned, forward pricing using futures and options offers many choices, some clear and some not so clear. Are there any rules of thumb that may provide assistance to decision makers?

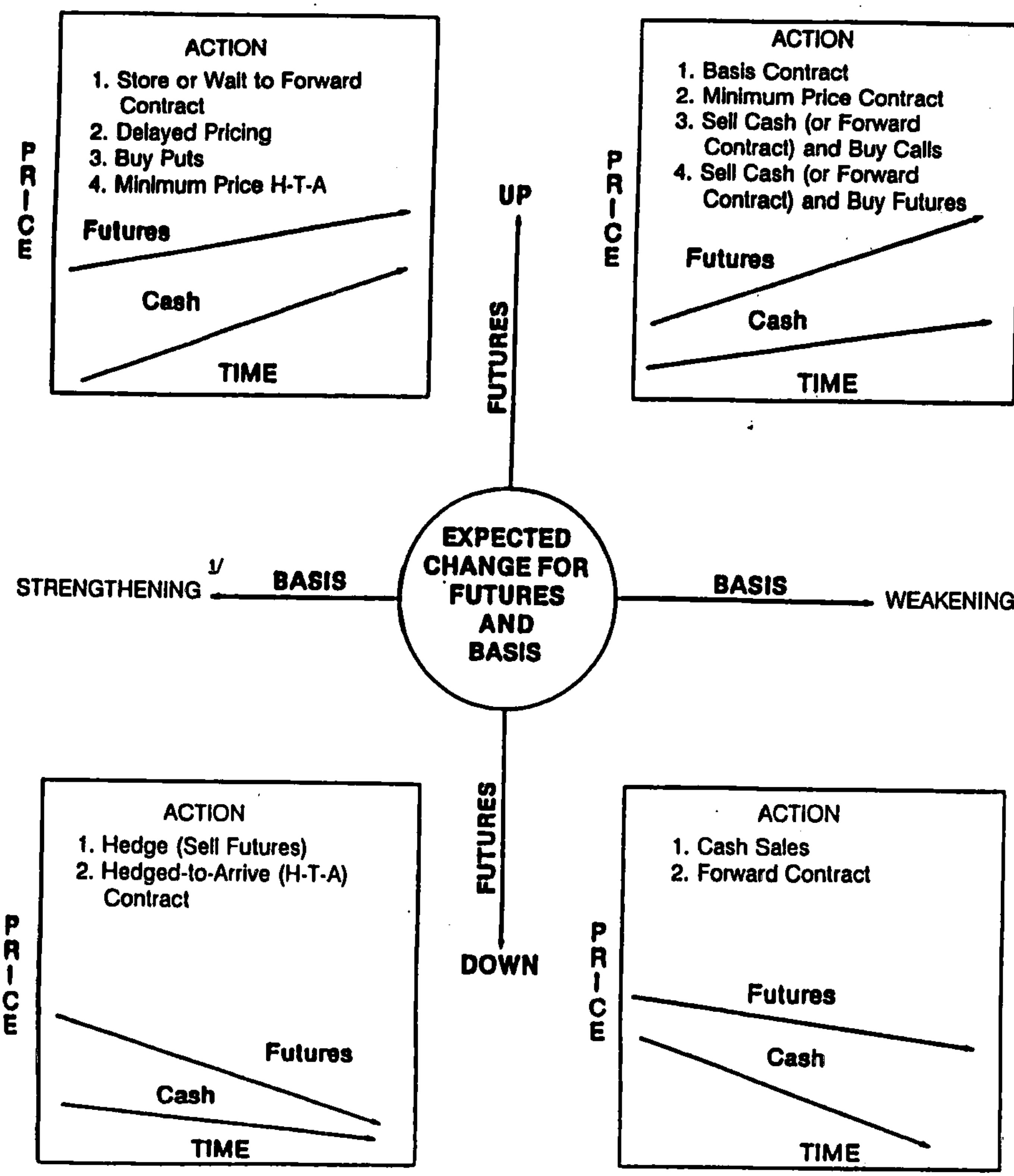
Emerging Rules

From the examples presented so far in this chapter, certain forward pricing guidelines emerge. These rules apply to the various alternatives included in the examples and some additional tools available to farmers and other commercial operators. The diagram in Figure 3.1 is an attempt to capture the essence of these rules on one page.

This figure introduces some new pricing instruments which are defined in the glossary of terms in Chapter 2. Delayed pricing is a variation on "storing or waiting to price" except the

Figure 3.1

Pricing Decision Chart for Cash Product Sellers



1/ Basis should strengthen enough to exceed storage costs.

Source: Derived from Developing Marketing Strategies and Keeping Records on Corn, Soybeans and Wheat, NCR Extension Publication No. 217, Producer Marketing Management - Fact Sheet #4, December 1985.

product moves on in the marketing system rather than remaining on the farm. The minimum price contract is with an elevator which guarantees a minimum price to the farmer in a way similar to the farmer's forward contracting and buying calls. The hedged-to-arrive (H-T-A) contract is like hedging and the minimum price hedged-to-arrive contract is like buying puts, except these actions are handled by the elevator--and, of course, basis is not locked in.

The four quadrants enumerate which tools are appropriate depending upon expectations about: (1) the direction of futures and (2) whether basis will strengthen or weaken. These combinations are also illustrated by the arrows labeled "Futures" and "Cash" diagrammed against "Time."

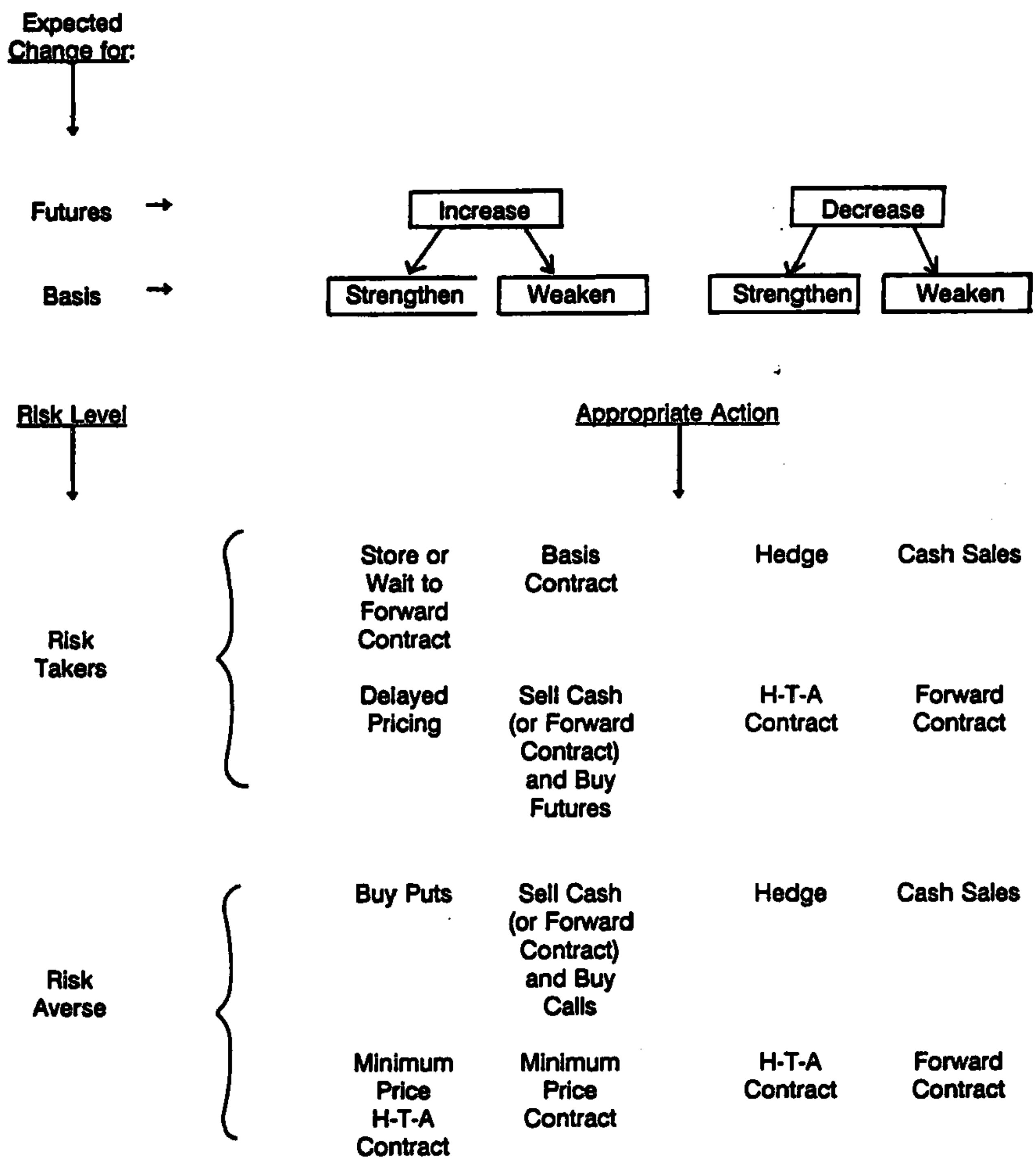
Figure 3.2 provides another perspective on choosing the appropriate forward pricing action, delineated by level of risk aversion. The rationale for the designations in this figure should be fairly obvious with a couple of comments to be added. The risk of an unfavorable move in futures is much greater than an unfavorable move in basis. Also, basis is more predictable than futures. For this reason, all of the instruments appropriate for the risk averse have futures locked in directly or indirectly (a forward contract implies that both futures and basis are locked in).

For risk takers expecting futures to rise, the four alternatives listed do not lock in futures. The alternative to "Sell Cash (or Forward Contract) and Buy Futures" is very much like a "Basis Contract," taking advantage of a favorable basis when the level of futures may not be attractive. Those bullish risk takers storing cash grain when basis is strong might better sell the grain and buy the equivalent in futures.

As can be noted, both the risk takers and risk averse should consider the same techniques if a decline in futures is expected. Of course, risk takers could ride the market down by selling more futures than needed to cover their cash position, but such action is not traditional for

Figure 3.2

Decision Tree on Selling Crops



commercial operators. However, one could argue that such action is no more speculative than carrying inventory unhedged.

Figures 3.1 and 3.2 could apply to selling livestock and other commodities with futures and options markets. Some of the contracts based on futures and options may not be available at this time, but similar contracts could be established by the industry.

More Exotic Forward Pricing Schemes

A number of other combinations could be explored in forward pricing. One is called a "synthetic put." This involves hedging (selling futures) and buying a call with a strike price closest to the underlying futures. This is similar to forward contracting and buying a call except that basis is not locked in--which also makes this procedure much like simply buying puts.

Another is called a "fence" which Robert Wisner describes as purchasing put options with strike prices near current futures prices and selling calls one strike price above the futures (Wisner, 1991). Selling calls helps pay for the purchases of the puts. The fence places both a lower bound and an upper bound on net prices received.

Other forward pricing schemes suggest selling calls. A bullish commercial operator could sell calls at a strike price above the current market, but considered to be attainable. If futures reach that strike price and the call is exercised (by a buyer), the seller would be assigned a short position in futures at that strike price. The seller would also pocket the premium. A disadvantage is that the call might not be exercised by a buyer.

Also, a bearish commercial operator could forward contract and sell a call with a strike price above the market. If futures drop, the value of the forward contract is enhanced by the premium less service charges. If futures rise and the call is exercised (by a buyer), the seller would be assigned a short position on another lot (5,000 bushels), which would be priced above the first contract. There is no guarantee, however, that the call will be exercised.

Other combinations of cash contracts, futures and options could be employed. A popular one is to sell out-of-the-money calls when long in the cash product. If futures remain about the same, this action enhances profits. If futures fall, the individual loses in the cash market, but pockets the premium on the call. If futures rise, increases in cash prices offset the losses on the call. In total, all the combinations discussed in this chapter represent an array which allows farmers and other commercial operators a great deal of flexibility in forward pricing to achieve profit objectives in line with risk preference.

Buying a Cash Product

Many of the same forward pricing techniques available for selling a cash product can also be used for buying a cash product. Processors who have established a selling price for their product may need to be assured that the cost of raw material still to be purchased will fit into the budget. A hog farmer may have forward contracted or hedged the sale of hogs, but still has soybean meal to buy. An exporter may have negotiated a sale of wheat still to be purchased.

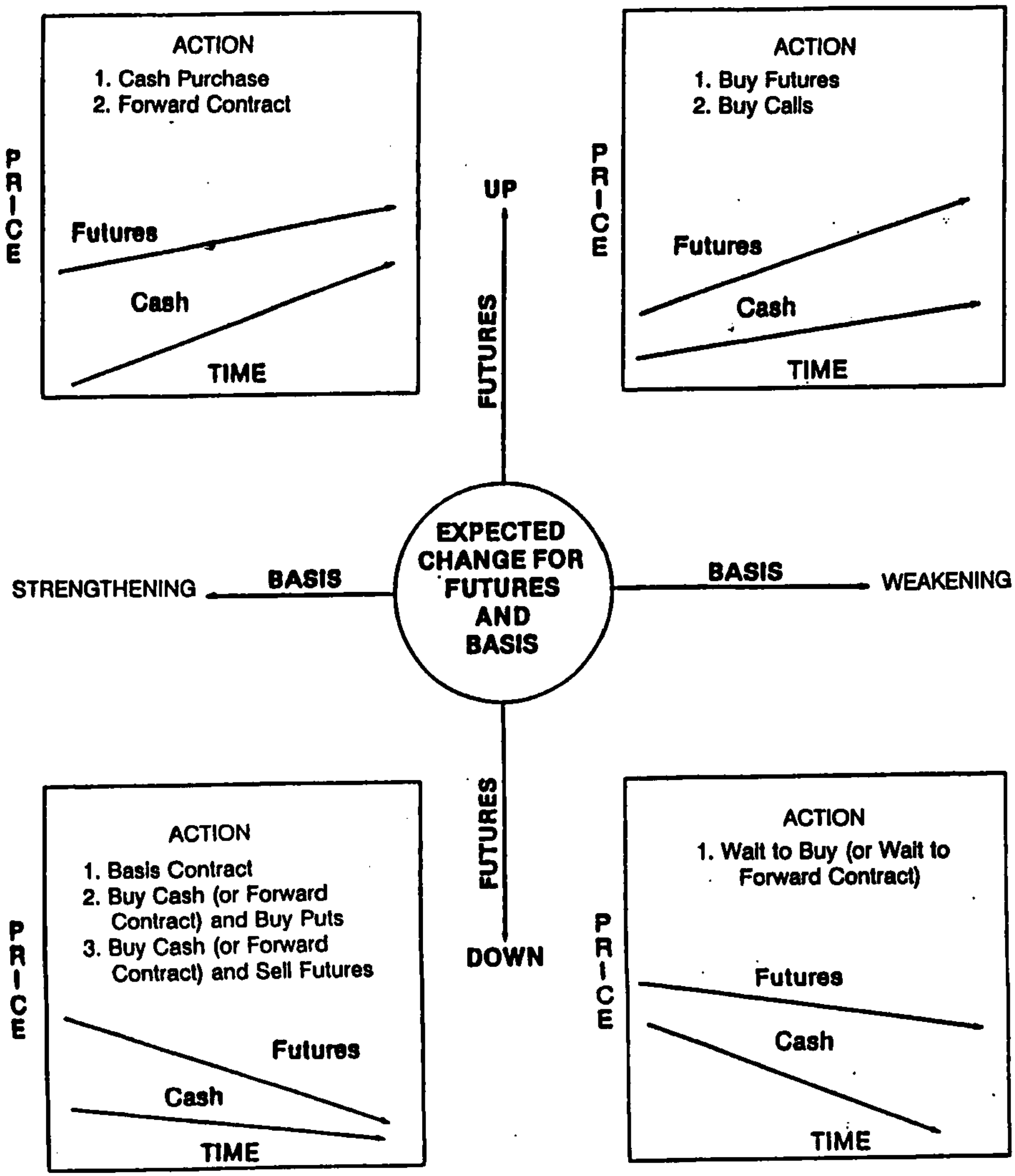
Such commercial operators need protection from an unexpected rise in the cash price of the item to be purchased. To establish an approximate price on the input, they would buy futures. Just as product sellers can establish minimum prices with options, buyers can establish maximum prices with options. This could be accomplished by buying calls.

Rather than a lengthy discourse on forward pricing a purchase, a brief reference to the parallel (in a mirror image sense) relationship to forward pricing a sale may be sufficient. Figure 3.3 is a guide similar to Figure 3.1 except that it is directed toward establishing prices on purchases.

If futures are expected to increase and basis to strengthen (upper left quadrant), the safest recommendation would be to buy the cash product now or forward contract it. If futures are expected to rise and basis to weaken (upper right quadrant), a purchase of futures would provide protection from rising cash prices, but allow cost savings from a weaker basis later on.

Figure 3.3

Pricing Decision Chart for Cash Product Buyers



A purchase of a call would lock in the right to buy at a price, setting the maximum by adding the premium and brokerage to the strike price adjusted for basis. Rising futures prices would be offset by higher premiums, and hopefully, cash prices would increase less. Alternatively, the buyer could take advantage of an unexpected drop in cash prices even as the calls become worthless.

If futures are expected to decline and basis to strengthen (lower left quadrant), the purchaser should enter a basis contract, if available. Alternatively, the purchaser should buy the cash product now or forward contract it (locking in the weak basis) and buy puts. The puts would cheapen the purchase with the decline in futures. If, unexpectedly, futures should rise, the buyer has established a maximum purchase price--the cash or forward purchase price plus the premium and brokerage on the put. In a similar action, the purchaser could sell futures rather than buy puts. Should futures decline as expected, the cost would be cheapened more than with buying puts, but with a futures rise, the net cost would not have an upper limit.

If futures are expected to decline and basis to weaken (lower right-hand quadrant), a risk taker wanting to buy a product would be advised to wait.

As indicated, which alternative buyers should pursue depends on their inclination and ability to handle risk, just as with those choices of sellers. Those commercial operators in volatile product and input markets should carefully consider protecting themselves on both sides. For example, soybean processors typically watch for opportunities to lock in favorable crushing margins by selling soybean meal and oil futures and buying soybean futures.

Basis--A Key to Effective Forward Pricing

As stated in Chapter 2, some deliveries are made on futures contracts which tend to keep cash prices and futures prices in line. Any buyer or seller of futures has delivery as an alternative. But few deliveries materialize simply because it is more profitable to buy or sell on local cash markets than to incur the transportation costs and other costs and the inconvenience of making or taking delivery. At the same time, if the cash and futures markets become far out of line, arbitrage will quickly bring them back in a competitive market.

Basis does vary over time due to localized supply-demand situations, transportation difficulties, structural change in the marketing system, etc. Also, grades and qualities of products which differ from the deliverable grade will experience more basis variability than for the deliverable grade (see Chapter 16). For effective hedging, variability in basis should be small relative to variability in the futures contract.

Basis can be measured in three ways. One is what is called "continuation basis" or basis relative to the nearby futures (Figure 3.4). This is simply the specific cash price less the futures price of the nearest contract month ahead. Basis defined in this way has the advantage that one can, on one table or chart, calculate the normal basis for any futures contract within two or three months of the expiration of that contract. The disadvantage is that the basis table or chart will exhibit discontinuities in the transition from one futures month to another.

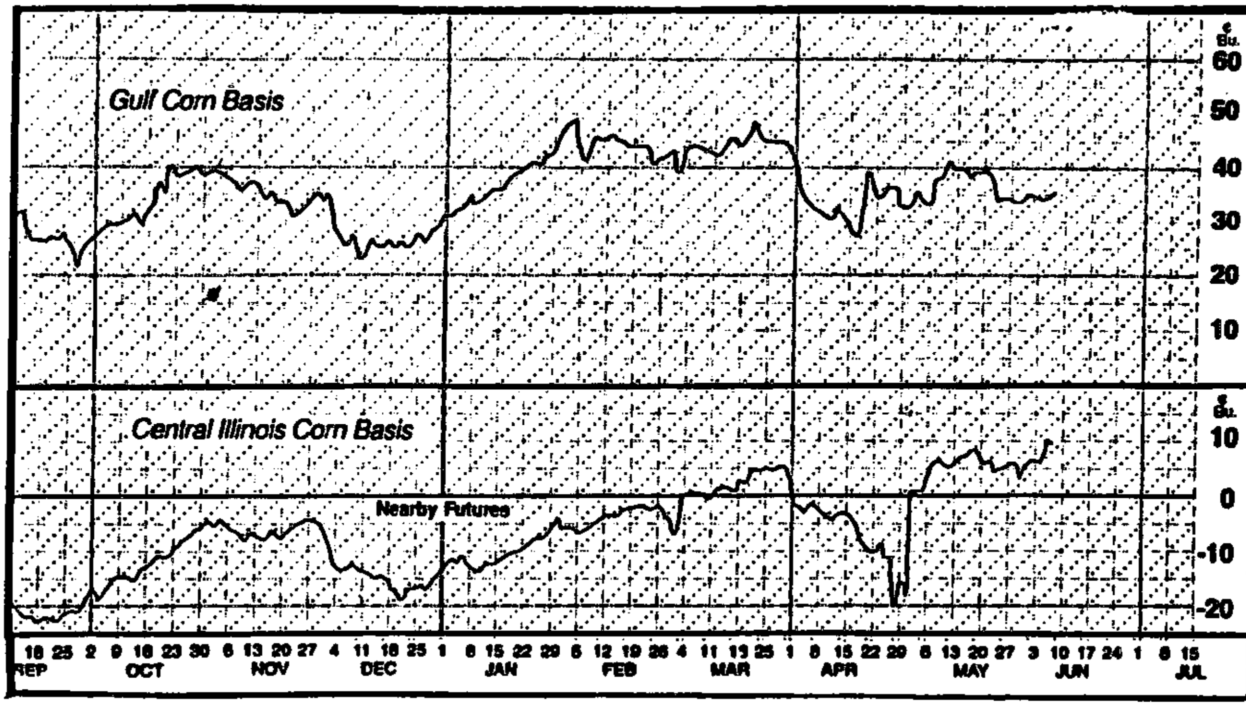
Another type of basis relative to crops is termed a "new crop basis" table or chart. This is the cash forward contract less the futures price nearest to and after harvest. This also could be applied to livestock--the forward contract price from a marketing agency less the futures price nearest to and following the contract time specification.

A third type of basis table or chart is termed "storage basis" and applies to crops. This basis is the current cash price less the futures price for some month during the storage season. Such a table or chart enables a commercial operator to determine the potential profit from storing and when to buy and sell from storage. A set of such tables or charts also indicates which futures month to use in a storage hedge. This is determined by the month which provides the most "carry" in the market; that is, "basis less storage costs."

Whether following a new crop basis table or a storage basis table, the most important information is the basis within a couple of months of the delivery date. This allows the hedger

Figure 3.4

A Continuation Basis Chart on Corn, with Cash Prices at the Gulf and in Central Illinois Compared with Nearby Futures on the Chicago Board of Trade, 1995-96



Source: Commodity Price Charts, Oster Communications, Inc., 219 Parkade, P.O. Box 6, Cedar Falls, IA 50613. Reprinted by permission from Commodity Price Charts, a weekly publication.

to evaluate whether the current basis is strong or weak and which of the many alternative forward pricing schemes promises the greatest profit. This is why continuation basis tables or charts are popular and instructive.

New Crop Basis

As an example, Figure 3.5 charts what can be called the "harvest or new crop basis" on corn sold at the Saginaw, Michigan terminal of Countrymark Cooperative, Inc., for 1982-93. The close parallel relationship between December futures on corn at the CBT and the Saginaw cash price from mid October to mid November can be observed in the top section of the figure. The bottom section is simply the difference in terms of the cash price minus the futures. The mean value of basis was -23 cents with a range from -16 cents to -37 cents and a standard deviation of 5.7 cents per bushel. In contrast, the standard deviation on December futures over this period was 45.5 cents per bushel. These are measures of basis risk in comparison with futures risk and can be calculated as a percentage--12.5 percent (5.7/45.5). On white wheat, which is not deliverable at the CBT, the harvest basis at Saginaw relative to September wheat at the CBT had a standard deviation of 10.4 cents versus a standard deviation for September futures of 48.3 cents, or a percentage of 21.5 percent. The lower the percentage, the more effective hedging can be in reducing price risk.

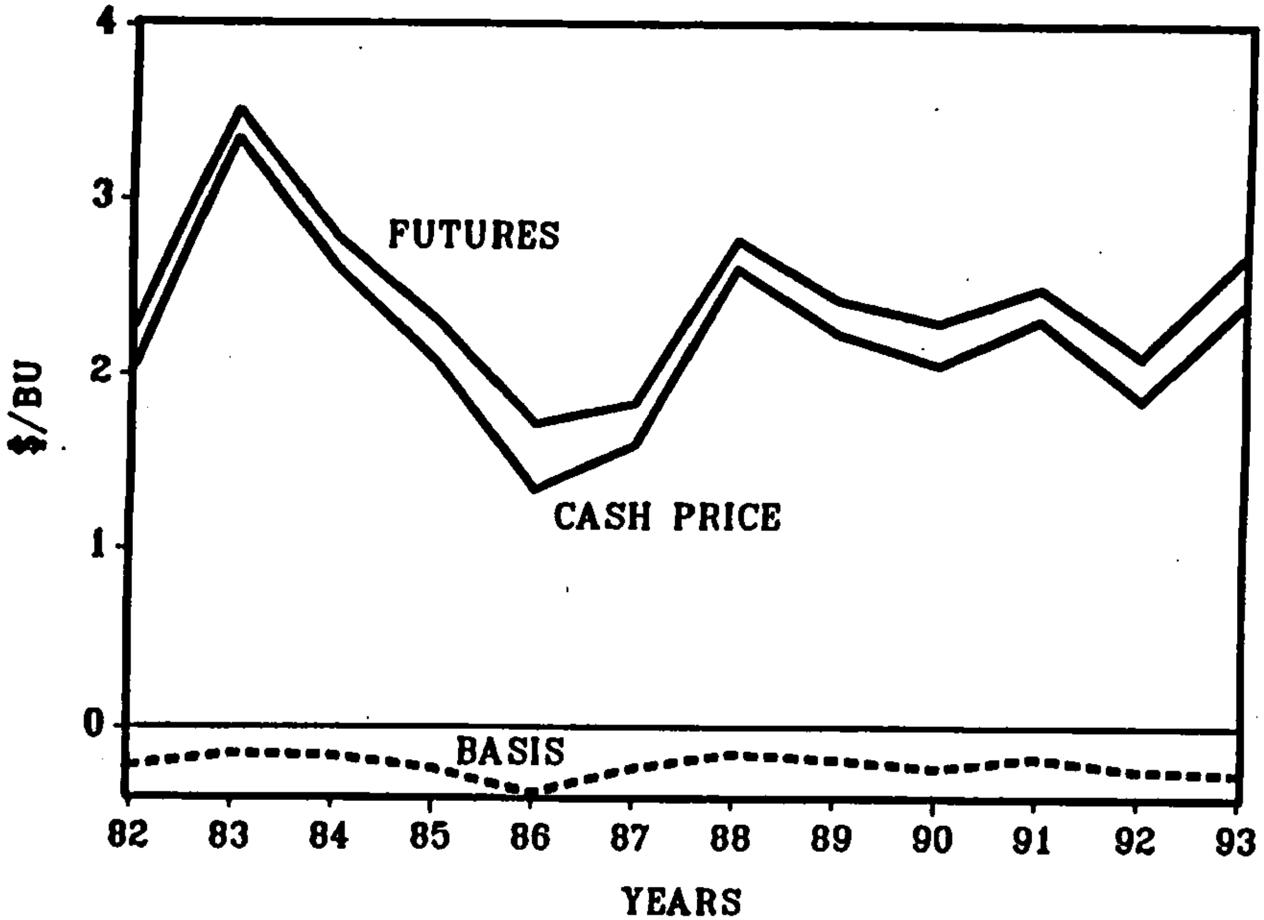
Storage Basis

The parallel movement of cash and futures prices on corn during a crop year is illustrated in Figure 3.6 for Saginaw in 1993-94. By close inspection, one can not only detect the high correlation between the week-to-week variation in the two series, but also the closing of the difference over the contract period. This closing represents a strengthening of the basis.

The basis pattern can be more clearly seen in Figure 3.7. This storage basis chart is calculated simply by orienting the cash price around July futures represented as a baseline of zero. As discussed earlier in this chapter, basis must strengthen over the storage period enough

Figure 3.5

Harvest Prices on Corn at Saginaw, MI,
December Futures at Harvest and Basis*



*Basis=cash price−futures. Harvest is from mid October to mid November.

Figure 3.6

Cash Corn Prices at Saginaw, MI, and
July Futures at the CBT, 1993-94

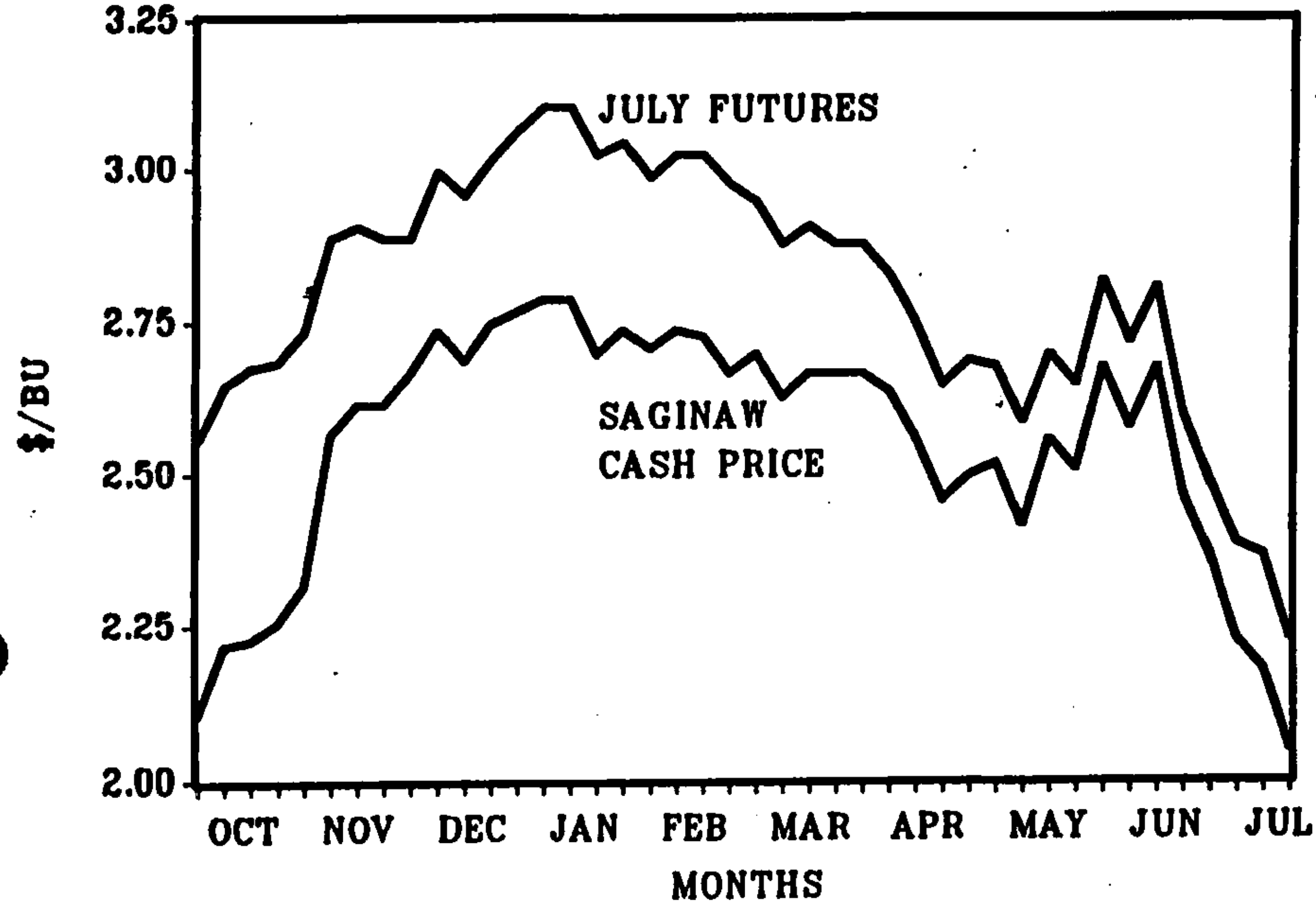
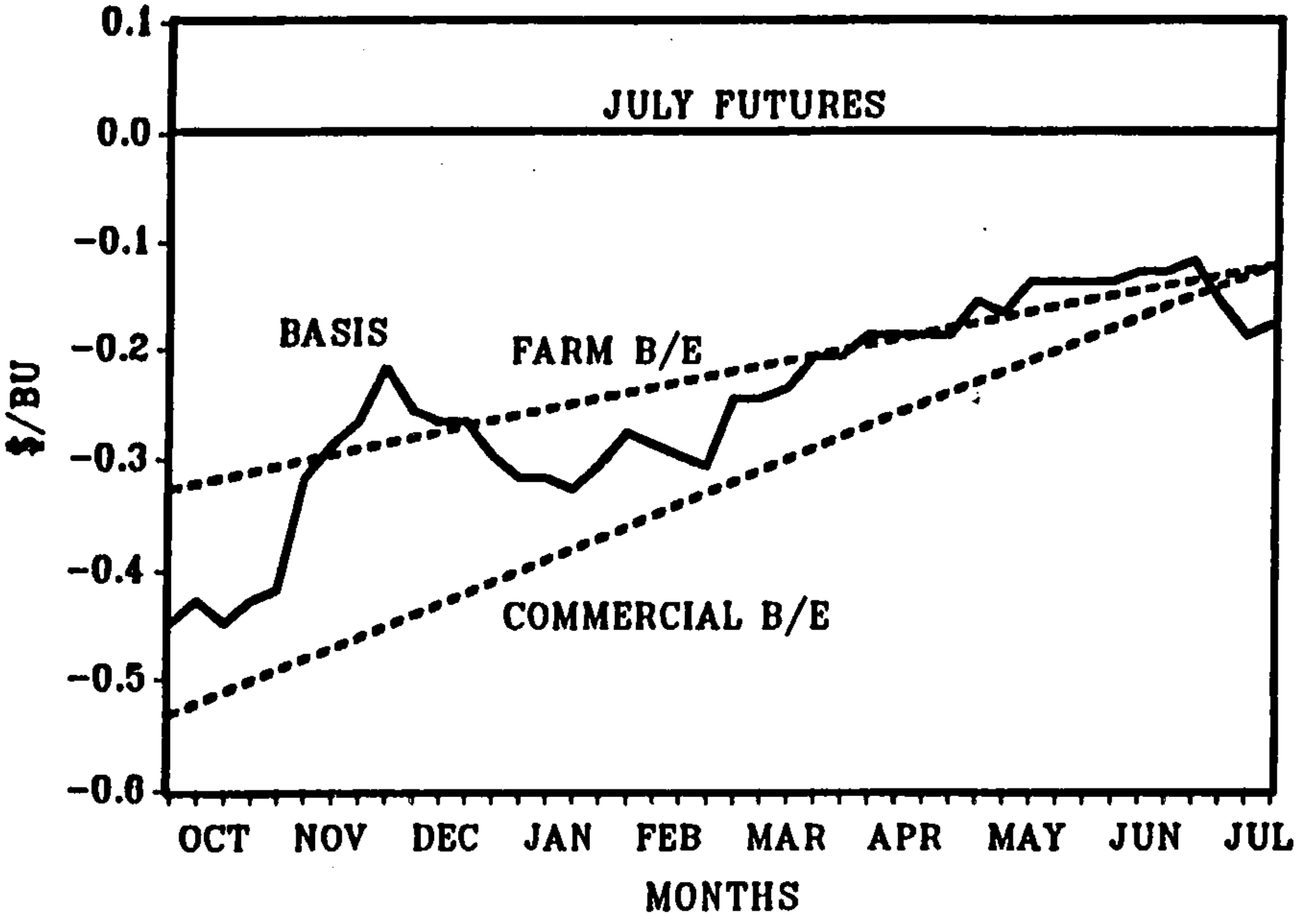


Figure 3.7

Basis Chart for Corn in Storage, 1993-94,
Cash Prices at Saginaw, MI, vs. July Futures



to cover storage (and brokerage) costs to make hedging a break-even proposition, and even more to make it profitable.

A farmer at harvest, in order to judge whether basis might strengthen enough to cover storage costs, has to evaluate the current basis in terms of what that basis might be toward the end of the storage period. To do this, records of past basis are invaluable. In this case, with respect to July corn futures, the Saginaw basis from mid June to mid July averaged -13 cents per bushel in 1982-92.

While the average of -13 cents per bushel for the previous 11 years might be a reasonable estimate of basis around the first of July for the current storage season, trends in basis caused by structural shifts in the marketing system might warrant computations from a more recent set of years. One forecasting technique for basis might be a moving average of the past five years. Alternatively, to cancel out unusual years, an average of three out of the last five years, omitting the high and low extremes (Olympic average) has merit. Applying this measurement for 1993-94, an expected basis for mid-June to mid-July of -12 cents was calculated and plotted at the right edge of Figure 3.7.

In order to evaluate, at any time between harvest and the end of the storage season, whether storage under a hedge will pay, a "break-even" line with an upward slope representing storage costs can be drawn with the expected basis at the end of the season as the fulcrum.

For a farmer or other commercial storage operator with existing facilities, the decision of whether a storage hedge would be profitable depends on direct costs and not the combination of direct and fixed costs. Fixed costs will be incurred regardless of whether a crop is stored. This direct cost can be calculated by multiplying the price of the crop at harvest by annual interest rates times the proportion of a year that the crop will be stored. What interest rate the commercial operator uses depends on whether the crop is stored on borrowed capital or whether the capital tied up in the crop represents foregone returns on investments of comparable risk. Some small additional direct costs relate to maintaining quality of the grain, insurance on the grain, etc.

In Figure 3.7, storage costs were calculated for two alternatives. One was using direct costs of storage on the farm multiplying short-term interest rates in the Midwest by the price of corn at Saginaw at harvest times two-thirds of a year. This, plus the small additional costs, amounted to about 20 cents per bushel. Deducting 20 cents from -12 cents resulted in -32 cents which is plotted on the left edge of Figure 3.7. Connecting that point to -12 cents on the right edge provided the construction of a break-even basis line at the farm, assuming existing facilities.

The commercial break-even line includes the interest cost on stored grain plus an elevator charge of three cents per bushel per month. These two lines in Figure 3.7 represent the range between minimal storage costs and toward the upper range of storage costs.

For a farmer with existing storage, the actual basis at harvest at Saginaw was well below the break-even line, suggesting storage under a hedge would pay. In practice, the farmer faces some "in" or "up-front" costs and might not be inclined to hedge unless basis was 5-10 cents per bushel below the break-even line at harvest.

Assuming this farmer did hedge, the break-even basis line provides a guideline on when to lift the hedge. The rise in basis above the farm break-even line in late November and early December was a signal to the farmer to lift the hedge; that is, buy back the July futures sold at harvest and sell cash corn. If the farmer remained bullish about the prospects for increases in the general level of corn prices at that time, he/she could establish a long position in futures. With basis that strong, prospects for profit were greater with futures than with cash or, on the downside, possible losses would be less with futures than with cash if prices declined.

A farmer who continued to store into June would still profit equal to the negative difference between basis and break-even basis at harvest, plus the positive difference between basis and break-even basis when the hedge is lifted. The unexpected weakening of the basis in July underscores a rule of thumb to lift hedges before the contract month at which time basis frequently becomes somewhat erratic.

A storage operator, with the break-even basis line similar to the farmer, would buy corn and hedge at harvest, lift the hedge in late November and early December; then buy corn in January and then lift the hedge in May or June. Basis trading will not generate large profits but will provide more assured income than betting on the movement of futures. Between January and June, a hedged inventory in 1994 would have collected a profit of about 10 cents per bushel in this example. An unhedged inventory would have lost 10 cents or so in the market, plus storage costs of another 10 cents per bushel.

Farmers or others storing commercially facing both foregone interest on the grain, plus a three cent per bushel per month charge, would not have tended to hedge at harvest because basis was above the "commercial" break-even line (Figure 3.7). Only in those periods when the slope of the basis line was greater than the slope of the commercial break-even line would hedging have paid, but those periods are difficult to predict.

Commercial storage costs are close to total costs for on-farm storage which include fixed costs. The expansion in storage facilities on and off the farm has resulted in ample capacity and a competitive industry. As a result, the "carry" in the market has not been highly attractive in recent years to encourage the construction of new facilities. The picture in Figure 3.7 for 1993-94 is fairly typical of the previous 10-15 years. Erecting on-farm storage still may be economical due to convenience and to the broader marketing alternatives available such as in trucking in larger lots and over greater distances.

Hedge Ratios

As mentioned earlier, farmers and others relying on forward pricing crops or livestock have an array of tools to fit their inclination and ability to handle risk. Another choice they can make is to determine the proportion of their cash position to hedge. The percentage of cash position which is hedged or priced with options is known as the "hedge ratio."

Farmers covering new crop sales in advance of harvest are dealing with anticipated production. The proportion of the expected crop to be forward priced depends on the variability of yield. If yields fall below 90 percent of trend frequently, but seldom below 80 percent, perhaps no more than 80-85 percent of the anticipated crop should be forward contracted or hedged--as a rule of thumb. The uncertain portion of the new crop could be priced with other tools such as options or not forward priced at all. Also, a farmer could purchase crop insurance and hedge up to the level of protection that insurance would provide.

A farmer fully hedged in the event of a short crop might have to buy futures back at a higher price than when the hedge was placed without having a similar amount of the cash product to offset losses in futures. This, of course, depends on whether the farmer's yields are positively correlated with national yields which tend to be negatively related to prices. This farmer would gain if over-hedged and futures fell.

If the amount of the cash product to be forward priced is clearly known, then 100 percent hedging could be considered. In fact, over the years, many elevator managers who did not fully protect their inventory, electing to speculate on some portion, lost their jobs in the process as the markets turned against them.

In "cross hedging," that is hedging a product substantially different than the futures contract, or in situations in which there is substantial basis risk, the commercial operator may want to calculate an "optimal hedge ratio." If the price variability between the cash product and futures is highly correlated, but the cash price is less variable, effective hedging could be accomplished with less than a 100 percent relationship between the amount hedged and the amount of cash product in inventory. If the cash price is more variable, effective hedging will require greater than 100 percent coverage.

Following procedures outlined by Myers and Thompson, and Stoll and Whaley, an OLS analysis was applied to week-to-week changes in cash prices on corn at Saginaw as a function of week-to-week changes in July futures at the CBT over the storage period from the first of October to the delivery period in the following July (Myers and Thompson, 1989; Stoll and Whaley, 1993).[1] The crop years from 1982-83 to 1993-94 were examined. Since the cash price at Saginaw is for No. 2 corn, the grade standard is close to the CBT delivery standard. Each crop year was analyzed separately.

For the 1993-94 crop year, the OLS results were as follows:

$$DPCN93 = .0071 + \underset{(20.41)}{1.063} * DFTJL93$$

$$\bar{R}^2 = .912 \qquad DW = 1.86$$

where: DPCN93 = change in the week-to-week price of corn at Saginaw, MI, in $/bu.

DFTJL93 = change in the week-to-week price of July corn futures at the CBT, in $/bu.

The constant reflects the weekly strengthening of basis of .71 cents, slightly above the estimated .50 cents for on-farm direct storage costs. The coefficient on DFTJL93 of 1.063 indicates the optimum hedge ratio; that is, selling 6.3 percent more futures than the long cash position in the corn inventory. However, the average coefficient for the 12 storage seasons for 1982-83 to 1993-94 was .915 with a range from .600 to 1.091. The conclusion in this case is that full hedging of the inventory is probably the best policy unless you have a technique to forecast the coefficient each year.

A similar conclusion was reached on hedging soft white wheat at Saginaw. Wheat is subject to more basis risk than corn because white wheat is not deliverable at Chicago. Over

[1]Myers and Thompson developed a more generalized model with conditions imposed but found the results very close to a simple regression using price changes.

the 12 storage seasons (July to mid November) from 1982 to 1993, the coefficient on the week-to-week change in December wheat futures, as these changes affected cash prices on white wheat at Saginaw, averaged .969, ranging from .762 to 1.207.

The only practical application of the optimal hedge ratio is with commodities which are: (1) quite dissimilar to the base grade of the futures contract or (2) far out of position to be delivered and for which transportation costs are a major element. If the coefficient on the first difference of futures turned out to be, say, around .5, then the cash product would require only half the volume of futures for effective hedging.

Relevant to the optimal hedge ratio for an individual farmer, who wants to protect gross income of a crop in advance of harvest, is the correlation between the yields of that farmer and national yields. If national yields impact prices in an inverse relationship, an unhedged farmer whose yields are closely correlated with national yields will be compensated by higher market prices, if prevailing yields are low. If highly hedged, this farmer might find gross income more variable than if he/she were not hedged. For this reason, such farmers would find their optimal hedge ratio less than farmers whose yields are not highly correlated with the national picture.

One advantage of using options to set lower bounds on prices received is that farmers whose yields correlate with the national average can receive compensating higher prices in the event of an unfavorable growing season. If prevailing yields are above average, such farmers also have sizeable crops to offset the lower prices bounded by the protection of the options.

In some situations, farmers may want to use hedge ratios well above 1.000. If futures are at unusually high levels and not likely to average higher the next several years, farmers could apply a hedge ratio of, say, 3.000, and forward price 75 percent of their expected production over the next four crop years. This would be accomplished by "rolling ahead" the remaining hedges as futures expire, i.e., buying back short positions and taking short positions in more distant futures.

Appropriate use of futures and options to enhance profits and manage risks is clearly a very complex process for an individual farmer or any commercial operator. While their understanding of the principles is essential, professional guidance may also be required. Timing in placing and lifting hedges, for example, is especially difficult for those not closely in tune with everyday market action. The following two chapters present many of the techniques used by professionals in forecasting such short-term price variations.

Notes