Risk and Resilience in Agriculture

Understanding and Using Basis - Grains

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Basis is defined as the amount in cents per bushel a specified local cash price is above or below a futures price for a specified delivery month.

Stated as a formula:
$Basis_t = Cash\ Price_t - Futures\ price_t$ where t equals time.

The term "basis" is often interpreted as the difference between the price of cash grain at a delivery point and the nearby futures contract. If on January 10, the cash corn price in a local market is $3.00, the nearby basis equals -$0.30 per bushel (-$0.30 = $3.00 - $3.30).

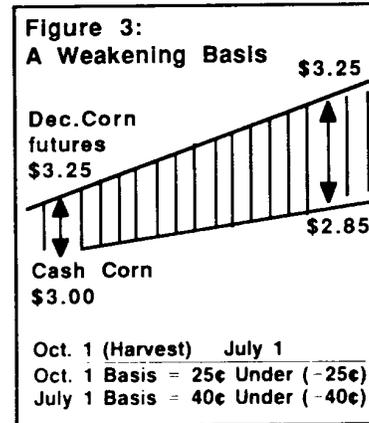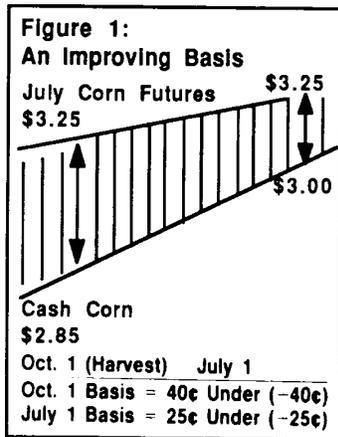Basis may also refer to the cash-futures relationship of a more distant futures month or to a deferred futures month. For example, on January 10, the July futures contract is trading at $3.45 per bushel. Since the cash price on that date is $3.00, the deferred July basis is -$0.45 (-$0.45 = $3.00 - $3.45). The negative sign attached to a basis specifies that the cash price is less than the futures price or is under the futures (Figure 1).

There are times when the formula generates a basis with a positive sign. This denotes that the cash price is greater than the futures price or that the cash market is trading at a premium to the futures (Figure 2). This relationship occurs because the supply/demand relationships in the local cash market are different from those prevailing in the futures market. The local supply of grain in the
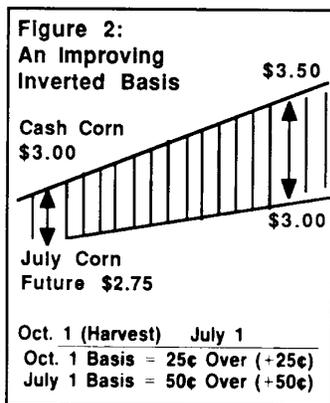
market may be limited relative to the perceived demand, or demand may be relatively higher than supply in the local market. Consequently, basis must include the corresponding mathematical signs for correct interpretation by farmers and grain handlers.

and spreads to develop marketing strategies. Farmers and grain handlers must understand basis and must record and use basis data to develop the perceived "optimum" marketing strategy or to select the optimum combination of marketing alternatives for selling grain.

Figure 1:
An Improving Basis
July Corn Futures $3.25
$3.25
$3.00
Cash Corn
$2.85
Oct. 1 (Harvest)   July 1
Oct. 1 Basis = 40¢ Under (−40¢)
July 1 Basis = 25¢ Under (−25¢)

By using the above formula and a simple spreadsheet or columnar pad, nearby basis data may be recorded daily or weekly. Similar data may also be recorded on tables prepared by Dr. John Ferris, Developing Marketing Strategies and Keeping Records on Corn, Soybeans and Wheat—Fact Sheet #4, NCR Extension Publication No. 217.

Dr. Ferris utilizes basis data in conjunction with forward contract prices, futures prices

Figure 2:
An Improving
Inverted Basis $3.50
Cash Corn
$3.00
$3.00
July Corn
Future $2.75
Oct. 1 (Harvest)   July 1
Oct. 1 Basis = 25¢ Over (+25¢)
July 1 Basis = 50¢ Over (+50¢)

Figure 3:
A Weakening Basis $3.25
Dec.Corn
futures
$3.25
$2.85
Cash Corn
$3.00
Oct. 1 (Harvest)   July 1
Oct. 1 Basis = 25¢ Under (−25¢)
July 1 Basis = 40¢ Under (−40¢)

Basis Patterns

To use basis to select the "optimum" marketing alternative(s), basis theory and the associated concepts must be understood. Because one important concept is basis patterns, examples are presented in Figures 1, 2 and 3. An improving basis by definition is one that changes from weak (wide, or the cash price is low relative to the futures price) to strong (narrow, or the cash price is high relative to the futures price). In Figure 1, a normal basis is weak on October 1 at -$0.40. By July 1, the basis is strong, equaling -$0.25. In Figure 2, the basis is weak in October, equaling +$0.25, and is strong on July 1, equaling +$0.50. A **weakening basis** changes from strong to weak. In Figure 3, a normal basis is strong on October 1 at -$0.25 and is weak by July 1 at -$0.40.

The terms "strong" and "weak" are relative terms. By definition, the present observed basis is strong when the present basis is greater than the historic average basis. For

example, assume that the average basis for hypothetical market A is -$0.35 per bushel. The present basis is -$0.10 per bushel. Therefore, by definition, the present basis is strong relative to the historic average. A second example of a strong basis follows. Assumed that for hypothetical market B that the average basis equals +$0.15 per bushel. Because the assumed present basis equals +$0.30 per bushel, a strong basis exists in market B.

By definition, the present observed basis is weak when the present basis is less than the historic average basis. For example, assume that the average basis for hypothetical market A is again -$0.35 per bushel. If the present basis in market A is -$0.50 per bushel, the basis is weak in market A. For market B, assume that the average basis equals +$0.15 per bushel. If the present basis in market B equals +$0.05 per bushel, the basis is also weak in market B.

The terms "strong" and "weak" have replaced the older terms "narrow" and "wide" to explain improving and weakening basis patterns. Historically, the cash price in most country elevators is normally under the futures price. The spread between the two prices improves or narrows throughout the marketing year (Figure 1). Recently, cash prices in some local markets are greater than the corresponding futures prices. As an inverted basis improves, the statement, "the basis is narrowing," becomes obsolete because pictorically the inverted basis is widening or is becoming more positive (Figure 2). Similar problems exist when using the term "widening" to explain a weakening basis pattern for an inverted basis.

Predictability of Basis

Although basis will vary throughout the marketing year, the variation tends to be more predictable and less extreme than changes in the price of cash grain. Most basis patterns are predictable because of the carrying charge, arbitrage between the futures and cash markets, and transportation costs. The carrying charge exists because stored commodities are harvested and stored one time each year while consumption occurs at a relatively constant rate throughout the year. There are financing, storage and management costs associated with the storage activity. Futures prices assuming rational behavior include forthcoming as well as past carrying charges while the prevailing cash price reflects only past carrying charges. Based on these arguments, it is probable that cash prices should increase in relationship to futures prices or basis should strengthen as the storage season progresses.

Because of the carrying charge, it is likely that the deferred futures price will be greater than the local cash price or that a basis with a negative sign will prevail at harvest time.[2] Basis often strengthens during the marketing year, as the local cash price captures the carrying charge. At the time the futures contract terminates, the action of arbitragers will cause the futures and cash prices to converge. That is, the arbitrager buys grain in the low priced market (cash or futures) and delivers and sells grain in the higher priced market (futures or cash) prior to the expiration of the futures contract. As grain is bought in the relatively low priced market, prices increase, and as grain is sold in the relatively higher priced market, prices decline. Although the cash price does not usually equal the futures price, even at the delivery points, the relationship between the futures and cash prices is relatively predictable at the

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[2] This is true for many local markets in the North Central Region. Often, however, river export and some country markets may have a positive basis at harvest time due to local supply and demand relationships and transportation costs.

termination of the contract.[3] The cash price may not be equal to the futures at the termination of the contract because of transportation and storage costs, freezing of waterways, delivery charges, unexpected or unusual events such as labor strikes and uncertainties about delivery points and grain grades.

Transportation costs also affect the local basis. The grain handler receives a price bid from a buyer, determines the transportation cost to deliver the grain and subtracts that cost from the price bid to determine the local price paid to farmers. For example, assume that the local grain handler has estimated a $0.20 per bushel cost to transport grain to a buyer. If the nearby futures is trading at $3.00, the buyer bids $2.95 to the grain handler, the farmer will most likely receive $2.75 per bushel price bid. The local basis then is -$.25 (-$0.25 = $3.00 - $2.75; $0.20 of which is a result of the transportation cost). Grain handlers forecast future basis by monitoring availability of rail cars, loading and unloadings of barges, ships that are waiting to be loaded and foreign and domestic demand reports. In general, increases (decreases) in transportation cost weakens (strengthens) the basis.

Although basis tends to strengthen during the marketing year and converges at the termination of the futures contract, daily, monthly and annual fluctuations may occur. The causes of these fluctuations are related but have unique differences. Several factors causing basis to fluctuate are:

1. **Supply and demand** — Basis will be stronger if the available supply of grain to the marketing system or to a given grain handler is scarce relative to the demand, e.g., a ship or train is waiting to be filled or a contract is open for an elevator and a limited supply of grain is available. On the other hand, if grain supplies are adequate to meet demands or local storage is inadequate for current harvest, a weaker basis results. This is the market's way of saying, "We don't want your grain at this time."

2. **Protein Supply** — Protein content of wheat in major wheat producing states influences local basis. If the protein supply is limited relative to demand, basis strengthens.

3. **Conditions of crop** — High moisture conditions may tax drying facilities and market grade requirements, resulting in a weaker basis during the harvest period.

4. **Transportation** — Availability of transportation (trucks, barges, trains and ships) to move the crop either at harvest time or during the market season can affect basis. Because many forms of transportation modes are not specific to grain, e.g., rail cars and barges, other commodities may take priority depending on economic conditions and demand.

Availability of transportation equipment to move grain compared to other commodities affects the cost of transportation for grain movement.

Increasing costs of transportation such as high fuel costs may weaken the basis to the producer.

The basis within a given market may vary depending on the transportation used. The type of transportation used for a market may change with the season and affect. basis, e.g., barge until the river freezes,

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[3] Futures and cash prices normally are not equal at non-delivery points or at country markets due to transportation costs. However, the ending basis at these country points is often predictable and can be used for making marketing decisions.

then rail grain. If rail rates are higher than barge rates, basis weakens as rail carriers are substituted for barges.

5. **Storage Availability** — Amount of storage available at a given location or market area can affect basis. If storage facilities are committed or demand for storage space is increasing, the basis will respond by weakening. This is the market's way of informing the producer to find storage elsewhere such as on the farm.

6. **Storage Costs** —The cost of storage is affected by two major factors; (1) general inflation and (2) interest. General inflation affects the cost of erecting storage facilities and the rates charged by commercial storage operators. As the costs to store grain on the farm increase or commercial storage rates increase, basis weakens. A second very important cost is interest, either foregone interest that could be earned on the cash from the sale of a commodity or interest actually paid to provide needed working capital in lieu of selling the grain. The interest cost of owning grain depends on length of time the crop is stored and the interest rate. The higher the interest rate and the longer the storage period, the weaker the basis due to the effects of interest alone. Remember, over time, market conditions change and many factors could cause the basis to strengthen even with accumulating storage cost.

7. **Seasonality of Harvest** — Grain crops are harvested over a short period of time. This places great demand on handling and transportation facilities during the harvest period. While some of the above factors such as transportation, crop conditions and supply are reflected in "basis" at various times, they combine to have the largest

effect on harvest basis. As one moves beyond the harvest period, basis strengthens in part as the demand for handling facilities decreases.

8. **Location Differences** — Basis varies among markets because distances to common demand centers vary, markets have unique demand centers; therefore, market A can ship grain to the Northeastern U.S. and Market B cannot, and different modes of transportation are available to different markets. That is, market A is on the river and has access to barge traffic while Market B, an inland elevator, has access to railroad and truck traffic only.

In conclusion, basis usually strengthens and converges as the contract maturity month approaches. This occurs because (1) the cash price is increasing to capture the storage cost, and (2) arbitrages enter the respective markets to buy and sell grain. Transportation variables cause basis to vary among locations, and other factors cause daily, weekly and annual fluctuations in basis patterns.

Basis and Marketing Alternative

Farmers must forecast change in futures prices and basis to select the "optimum" marketing alternative.[4] Transforming the basis formula:

$$Basis_t = cash\ price_t - futures\ price_t$$
results in
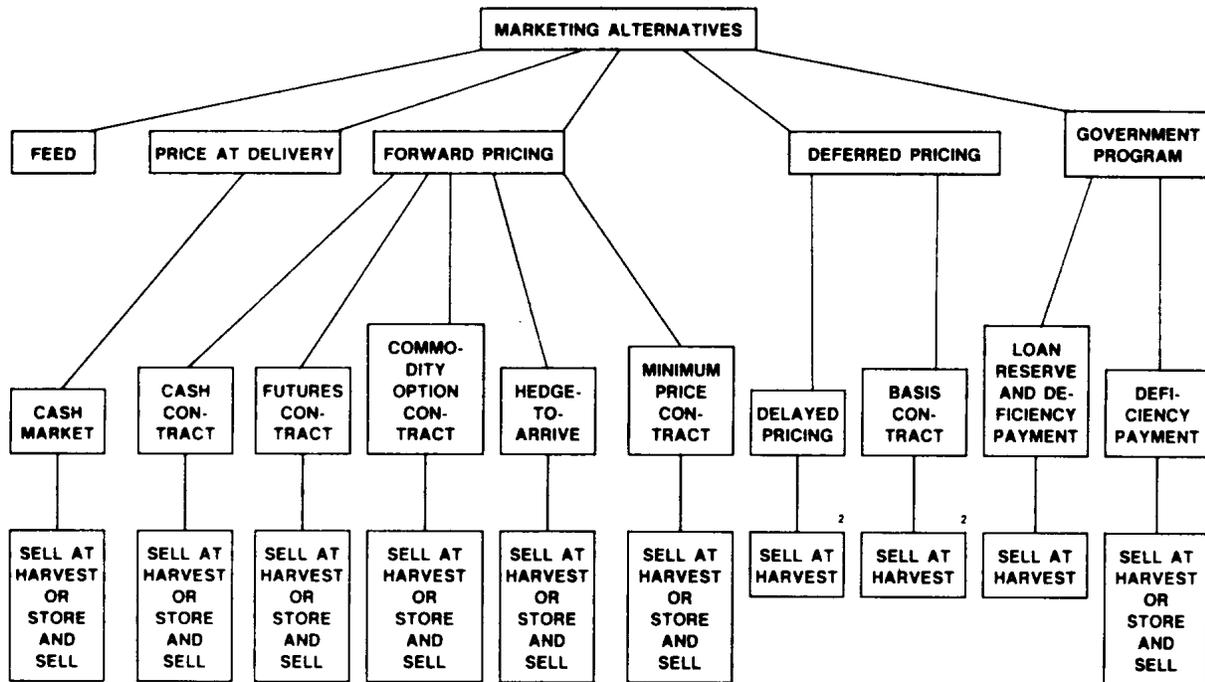$$cash\ price_t = futures\ price_t + basis_t[5]$$
where $_t$ is time.

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[4] When the expected basis is negative, the cash price is less than the futures. For example, if the futures price is $2.50 and the expected basis is—$0.25, the cash price equals $2.25 ($2.25 = $2.50 —$0.25)

[5] Outlook information and private forecasters provide insights for future price movements. Historic basis data are used in conjunction with storage, transportation, supply and demand information to forecast basis movement.

The futures price is acquired from the futures market where buyers and sellers are continually registering international and domestic supply-demand relationships. When futures prices increase (decrease), prices paid to farmers also increase (decrease). The basis quote is derived from the local market where grain handlers continually monitor local supply and demand relationships and compete for grain. Because of local competition, expected storage and transportation costs and

storage actions and one of the many marketing alternatives (Figure 4).[6] By forecasting the price and basis movements, a four quadrant pricing chart may be used as a "tool" by farmers to select the optimum marketing alternative for selling grain (Figure 5).
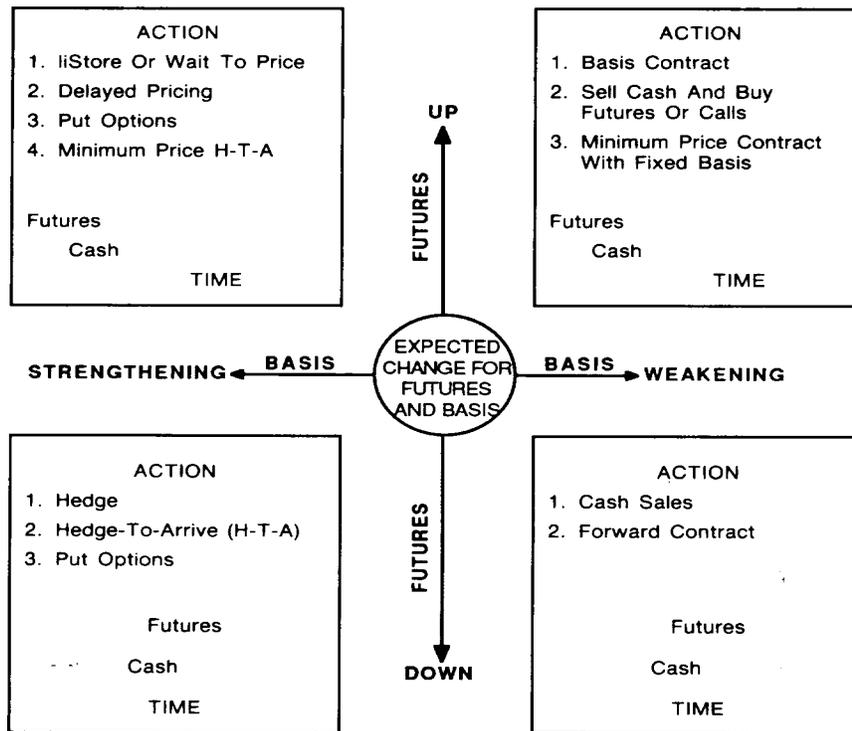
Figure 4. Marketing Alternatives

. Grain is sold to a grain handler and the loan is repaid or is not accepted.
2 Although most Delayed Price and basis contracts are signed at harvest, grain can be stored and contracts signed during the storage period.

price bids from buyers, grain handlers respond by alternating basis to increase or decrease the flow of grain. To acquire more grain locally, grain handlers strengthen the basis, and bid up cash prices. In contrast, grain handlers weaken the basis to obtain less grain.

Farmers must forecast the change in both futures price and basis to select appropriate

[6] Figure 4 shows marketing options that may not be available currently but are included here for purposes of discourse, historical basis patterns and marketing options.

Figure 5: Pricing Decision Chart on Crops[1]

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┌─────────────────────────────────┐              ┌─────────────────────────────────┐
│           ACTION                │              │           ACTION                │
│ 1. liStore Or Wait To Price     │      UP      │ 1. Basis Contract               │
│ 2. Delayed Pricing              │       ▲      │ 2. Sell Cash And Buy            │
│ 3. Put Options                  │       │      │    Futures Or Calls             │
│ 4. Minimum Price H-T-A          │   FUTURES    │ 3. Minimum Price Contract       │
│                                 │       │      │    With Fixed Basis             │
│ Futures                         │       │      │ Futures                         │
│     Cash                        │              │     Cash                        │
│           TIME                  │              │           TIME                  │
└─────────────────────────────────┘              └─────────────────────────────────┘

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STRENGTHENING ◄── BASIS │EXPECTED │ BASIS ──► WEAKENING
                        │CHANGE FOR│
                        │ FUTURES │
                        │AND BASIS│
                        ╰─────────╯

┌─────────────────────────────────┐              ┌─────────────────────────────────┐
│           ACTION                │   FUTURES    │           ACTION                │
│ 1. Hedge                        │       │      │ 1. Cash Sales                   │
│ 2. Hedge-To-Arrive (H-T-A)      │       │      │ 2. Forward Contract             │
│ 3. Put Options                  │       │      │                                 │
│                                 │       │      │                                 │
│         Futures                 │       ▼      │         Futures                 │
│      Cash                       │     DOWN     │      Cash                       │
│         TIME                    │              │         TIME                    │
└─────────────────────────────────┘              └─────────────────────────────────┘
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[1] Government program alternatives omitted from discussion. These marketing alternatives would not be selected where the loan rate is above the cash price and the farmer elects to participate in the program.

Pricing Chart: Price Increase and/or Basis Weakens

In the upper right quadrant, it is assumed that the futures price will increase and the basis weakens. Although the anticipated change in cash price is indeterminate (cash price may increase, decrease or remained unchanged), the selected marketing alternative should capture the potential increase in futures price or should offset the anticipated weakening of the basis. Three marketing alternatives, 1) sell a commodity via a basis contract (fix the basis and speculate on the expected futures price increase), 2) sell grain via the cash market and buy futures or a call option (speculate in the futures) or 3) sell grain via a minimum price contract with a fixed basis (speculate on expected price increase) will achieve these objectives.

For example: $Cp_t = Fp_t + B_t$[7]

1. Today's date (t), $3.00 = $3.50 - $0.50
2. It is forecast that futures price increases to $3.75 and/or basis weakens to -$0.75 in time period (t +1).
3. In time period t, basis contract or a minimum price contract is sold, fixing basis at -$0.50 or cash grain is sold and go long (buy) futures or a call option.
4. At some future date (t +1) assume the above forecast prevails:
   $$Cp_{t+1} = Fp_{t+1} + B_{t+1}$$

   A. Cash price: $3.00 = $3.75 - $0.75

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[7] Cp = Cash price; Fp = futures price; and B = basis.

B. For the basis contract or the minimum price contract: $Cp_{t+1} = Fp_{t+1} + B_{t+1}$ ($3.25 = $3.75 - $0.50) farmer sells cash grain at $3.00 and buys futures or a call option at $3.50 in time period (t). Later in time period (t +1), the farmer sells futures or a call option at $3.75 earning gross profit of $0.25; gross price realized is $3.00 + $0.25 = $3.25. In this example, all three marketing alternatives return $0.25 more than the markets alternative sell cash grain in time period (t). All marketing costs must be subtracted from the gross prices to identify the optimum marketing alternatives

A. Cash price: $2.50 = $3.25 - $0.75

B. Prior cash sales price in time period ($_t$) was $3.00; therefore, the cash sales alternative netted $0.50 (plus any storage cost savings) relative to cash sales in time period (t +1).

C. Grain sold via a forward contract ($3.15) in time period (t) grosses $0.65 over current cash price in (t+1) of $2.50. Net price would be less because of storage costs. Whether a forward contract is sold or cash grain is sold depends on the expected net price (forward contract price minus storage cost relative to current cash price).

Pricing Chart: Prices Decrease and/or Basis Weakens

In the lower right quadrant it is assumed that basis weakens and futures price decreases. Because the cash price is expected to decrease, the selected marketing alternative should offset this marketing outcome. Two marketing alternatives (sell cash grain or sell a forward contract) accomplish this objective.

For example: $Cp_t = Fp_t + B_t$

1. Today's date (t), $3.00 = $3.50 - $0.50

2. It is forecast that futures price decreases to $3.25 and basis weakens to -$0.75 in time period (t+1).

3. Cash grain is sold at $3.00 or a forward contract is sold at an assumed price of $3.15 in time period (t).

4. At some future date (t+1), assume the above forecast prevails:
$Cp_t = Fp_{t+1} + B_{t+1}$

Price Chart: Prices increase and/or Basis Strengthens

In the upper left quadrant, it is assumed that futures price increases and basis strengthens. Because the cash price is expected to increase, the selected marketing alternative should capture this change. Four alternatives (store grain and price later, sell a delayed price contract, buy a put option or market grain via a minimum price hedge-to-arrive contract) will accomplish this goal.

For example: $Cp_t = Fp_t + B_t$

1. Today's date (t), $3.00 = $3.50 - $0.50

2. It is forecast that futures price increases to $3.75 and/or basis strengthens to -$0.25 in time period (t+1).

3. At some future date (t+1), it is assumed that the above forecast prevails:

$Cp_t = Fp_{t+1} + B_{t+1}$

A. Cash price: $3.50 = $3.75 - $0.25.

B. For those who stored, selected a delayed price contract, bought a put option or sold via minimum price hedge-to-arrive, a gross gain of $0.50 was earned in time period (t+1) relative to selling grain via the cash sales alternative in time period (t). To determine the net gain, storage cost, delayed price service fees, and option and minimum price hedge-to-arrive premiums must be subtracted from the gross gain.

C. To determine the best marketing alternative, determine and compare the net gain from each alternative.

Pricing Chart: Prices Decrease and/or Basis Strengthens

In the lower left quadrant, it is assumed that futures price decreases and basis strengthens. Because the magnitude of these two changes varies, the change in cash price is indeterminate. The farmer has three alternatives, hedge in the futures market, obtain a hedged-to-arrive contract with an elevator or buy a put option contract. Because the outcome for the hedge and hedged-to-arrive contract are nearly identical, only one example follows:

$$Cp_t = Fp_t + B_t$$

1. Today's date (t), $3.00 = $3.50 - $0.50

2. It is forecast that futures price will decrease to $3.25 and/or basis will strengthen to -$0.25 in time period (t +1).

3. A hedge is placed.

4. At some future date (t +1), it is assumed that the above forecast prevails:
$Cp_{t+1} = Fp_{t+1} + B_{t+1}$
   A. Cash price: $3.00 = $3.25 - $0.25

   B. Price from futures: Price from futures falls by $.25 resulting in a gain of $.25 on the futures or the basis strengthens by $.25 or some combination of these two events to realize a $.25 gain, as assumed in 4 above.

   C. This is a gross gain; to determine the

	Cash Market	**Futures Market**
Prior Action: (t)	Stored grain	Sold futures contract or hedged-to-arrive contract or buy put option $3.50
Future Action: (t+1)	Sold cash $3.00	Bought futures contract or sold put option and delivered grain when futures equaled $3.25.
Gain in two markets:	$0.00	+ $0.25
Price received for grain in period (t+1) is $3.25 or $0.25 is earned relative to cash alternative in period (t).		

net gain, storage and marketing costs must be deducted for the hedge or put option alternative while storage costs are deducted for the hedged-to-arrive contract.

Summary

Farmers must understand the principles and theory that underly the basis concept. Basis data must be maintained and must be used to select marketing alternatives. For additional references see **Developing Marketing Strategies and Keeping Records on Corn, Soybeans and Wheat**, NCR Extension Publication No. 217) Fact Sheet #4 by Dr. John Ferris, Michigan State University.

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