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BASIS--THE KEY TO EFFECTIVE FORWARD PRICING

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Understanding "basis" is the key to making futures and options markets work for the hedger. Simply put, "basis" is the difference between some specified cash market price and some specified futures contract. Since the futures contract is specific in terms of grades, location and other terms of delivery, the cash price used in calculating basis needs to be clearly identified relative to grade and location.

Formally, the standard definition of basis is, in equation form,

$$\text{Basis} = \text{Cash} - \text{Futures}$$

Since cash prices on products farmers sell are usually below futures, basis is usually negative. A strengthening of the basis means that basis is becoming less negative. Should basis become positive, a stronger basis means that it is becoming more positive. On the other hand, weakening of basis means that it is becoming less positive or more negative.

The key to effective hedging and use of options is that the basis is reasonably predictable, especially as delivery time approaches on a particular futures contract. At delivery time, the cash market for the same quality of product at the delivery point should be essentially the same as the futures price. Cash markets at other locations at delivery time should be below the futures price approximately by the cost of transportation to the delivery point plus handling.

Basis varies from year to year due to local supply and demand conditions, availability of storage, transportation and storage costs and unexpected developments in market fundamentals. Also, if the product being hedged differs in specification and quality from the futures contract, basis risk will be greater.

For effective forward pricing with futures and options, basis risk should be small relative to the variability in the general level of futures and cash prices. A comparison between the two risks can be seen in Figure 1 which shows December futures and Saginaw cash prices on corn at harvest (mid October to mid November) from 1973 to 1987.

New Crop Basis

Note that the major changes in harvest prices from year to year are reflected in a parallel fashion in both futures and cash markets. Some differences in the margin between the two prices can be detected from year to year, but these differences are small relative to the changes in the general level of prices. Year-to-year changes in futures prices were typically 50 cents to a dollar while basis changes were more like 10-20 cents. The change in basis is more clearly seen in Figure 2 which plots harvest basis on corn at Saginaw relative to December futures from 1973 to 1987. In 1973 to 1987, the standard deviation (a statistical measure of variability) in harvest basis on corn was $.13 per bushel compared to a standard deviation of $.47 in the level of futures prices. The ratio of basis standard deviation to futures standard deviation was .28, a measure of basis risk in comparison with futures risk.

The basis chart on corn (Figure 2) indicates that basis has strengthened at Saginaw over the past decade. A reasonable expectation is that harvest basis will be about $-.30 $\pm$ .10. Figures 3 and 4 plot the harvest basis at Saginaw on soybeans and white wheat. As with corn, harvest basis on soybeans

Figure 1

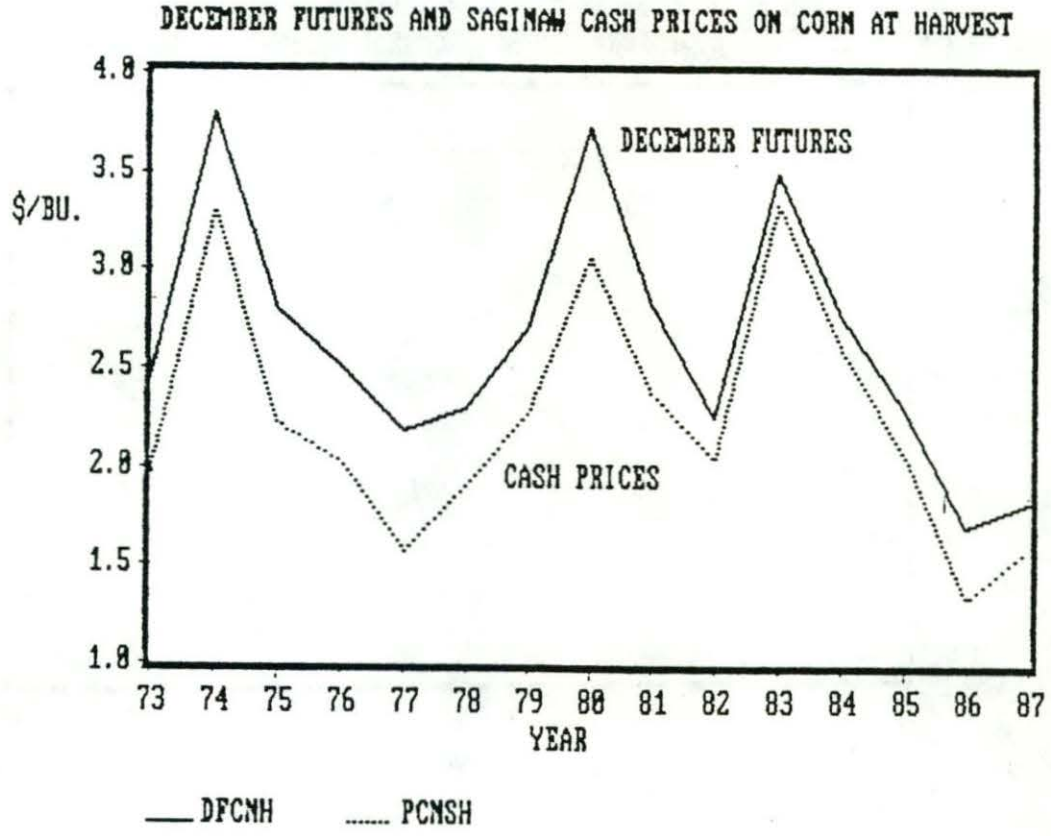


Figure 2

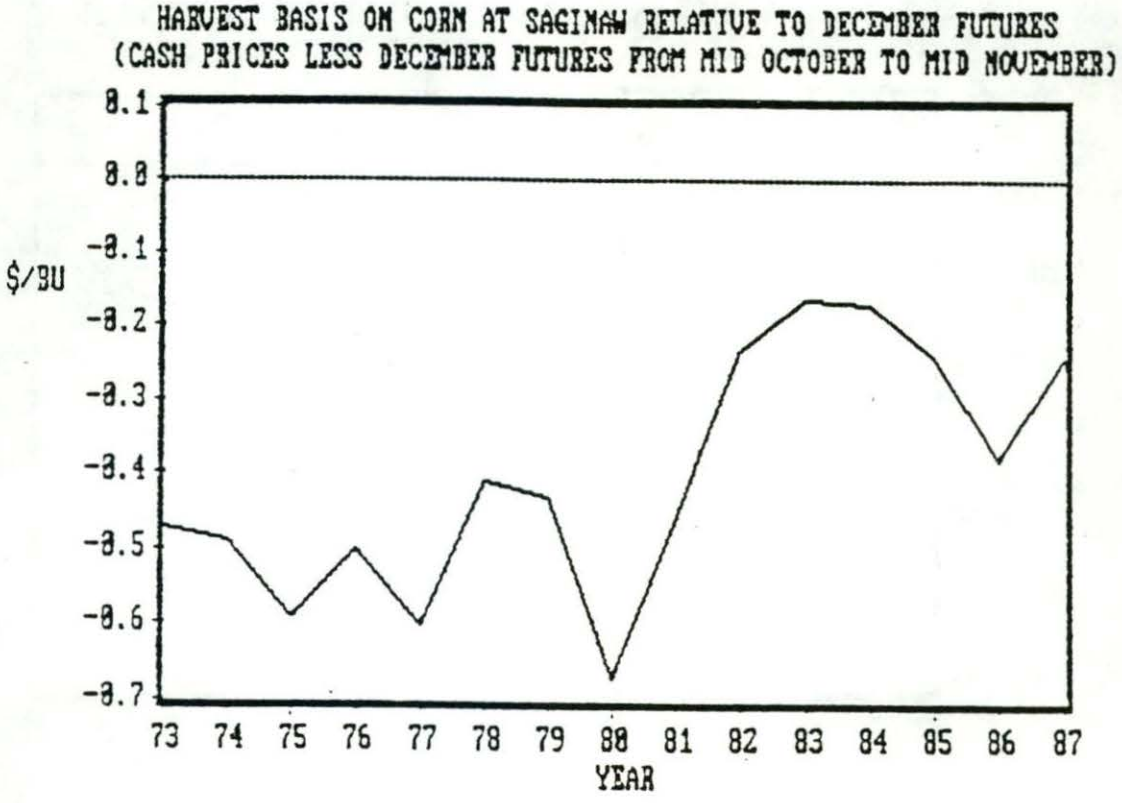


Figure 3

HARVEST BASIS ON SOYBEANS AT SAGINAW RELATIVE TO NOVEMBER FUTURES
(CASH PRICES LESS NOVEMBER FUTURES FROM LATE SEPTEMBER TO LATE OCTOBER)

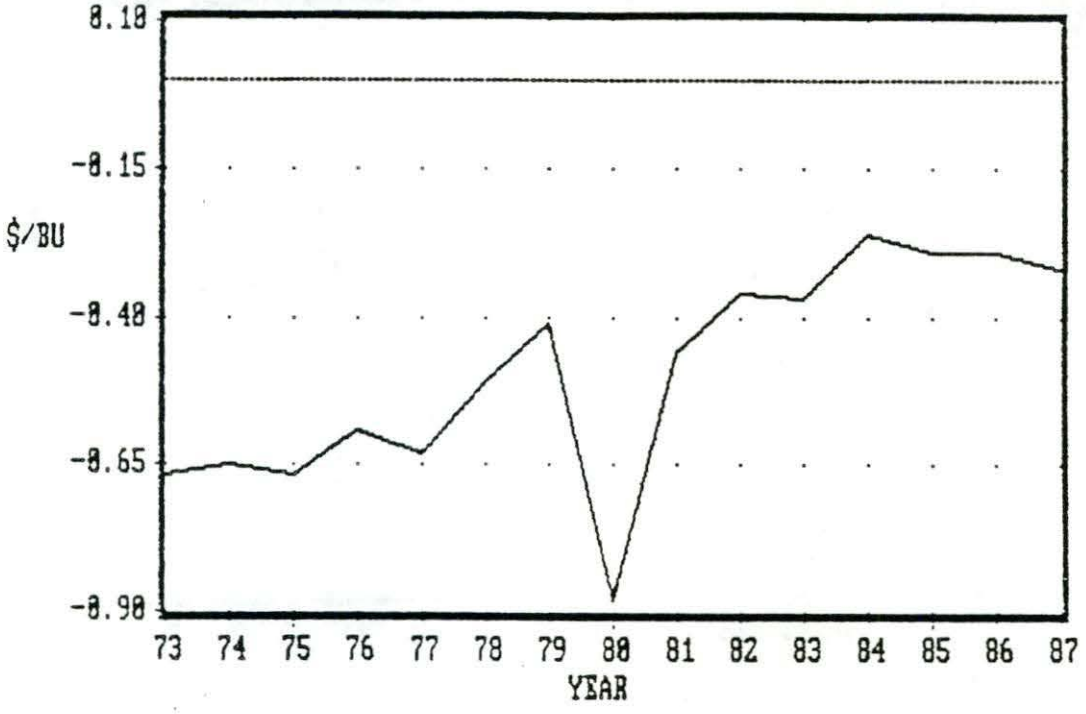
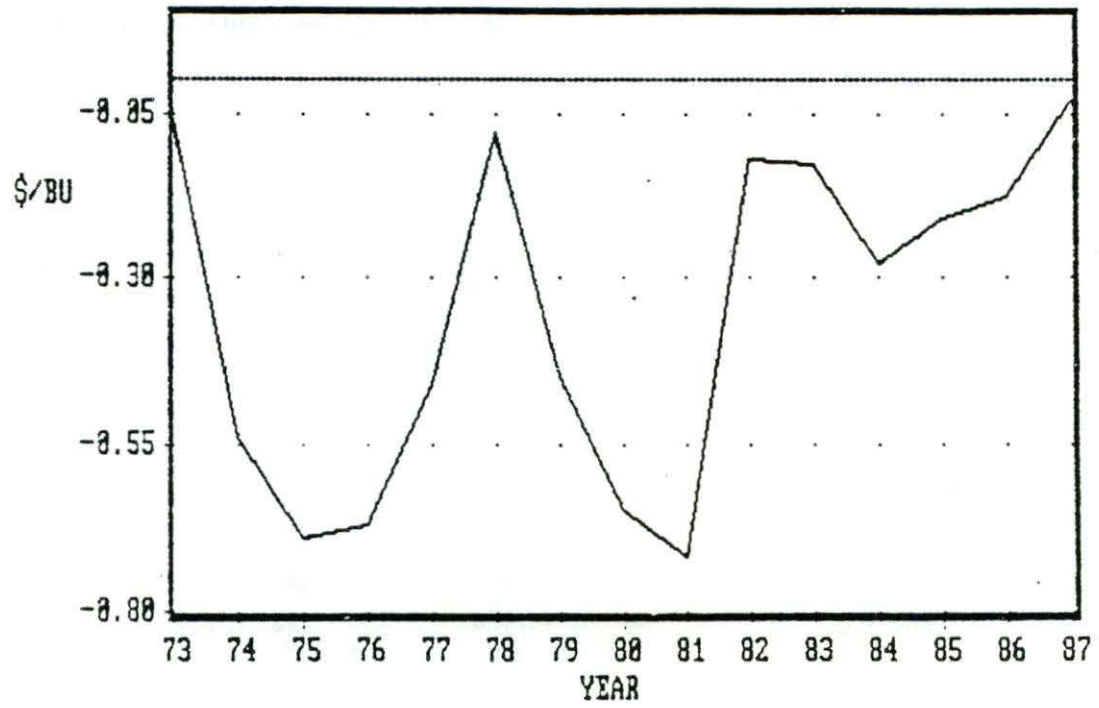


Figure 4

HARVEST BASIS ON WHITE WHEAT AT SAGINAW RELATIVE TO SEPTMBER FUTURES
(CASH PRICES LESS SEPTEMBER FUTURES IN MID TO LATE JULY)



(cash prices less November futures from late September to late October) has converged to $-.30 per bushel in recent years. The ratio between the standard deviation on basis and on futures is quite small -- .12. This means that risk can be reduced substantially by hedging soybeans.

On white wheat, however (Figure 4), harvest basis has been highly variable, ranging from $-.05 to $-.70. Harvest basis on white wheat is calculated by subtracting September futures from cash prices at Saginaw in mid to late July. The standard deviation of harvest basis on white wheat relative to the standard deviation of September wheat futures (CBOT) at harvest was .33 in 1973-87. This means that substantial risks remain even if new crop white wheat is hedged (or puts purchased). One reason basis is so variable on white wheat is that it is not deliverable at Chicago or Toledo. Soft red is the only deliverable class.

Harvest basis charts can be very useful for evaluating forward pricing alternatives. From Figures 2-4, farmers selling at Saginaw could estimate that cash prices at harvest would tend to be about $.30 under nearby futures on corn and soybeans and $.20 - .25 under on white wheat. The chart also provides some indication of basis risk.

Storage Season Basis

Within a crop year, cash prices at country points in months prior to delivery should be below the given futures price by transportation costs to the delivery point plus the costs of storage to the delivery time. In order to obtain a conceptual idea of these relationships, consider what the picture might be in a "perfect market" in which all supply and demand factors are known by all buyers and sellers and in which the physical product flow normally passes through the point where the futures market is located.

This situation is illustrated on corn in Figure 5, assuming the focal point for both the futures and the cash markets is Chicago. The cash price for No. 2 corn at Chicago declines to a low at the peak of harvest around November 1 and then climbs steadily to a high around August when new crop corn begins to be harvested in the South. The increase from $2.20 at harvest in this hypothetical case to $2.60 in August represents about 1 cent per bushel per week, presumed to be enough to cover storage (carrying) costs including "normal" profits. This is about the costs farmers would incur if they stored at the local elevator.

Since knowledge is perfect, March and July futures in Figure 5 are plotted as straight horizontal lines. At delivery time (third week in the respective months), March and July futures converge with cash prices at Chicago. Note that, at any time prior to delivery, the cash price at Chicago is below March futures by the storage cost to the third week in March. Also, cash prices are below July futures by the cost of storage to the third week of July. Also apparent is the fact that July futures, at any point, are above March futures by the cost of storage from March to July.

The Saginaw cash price is parallel to and 20 cents per bushel under the Chicago cash price. This hypothetical 20 cents represents the cost of transportation between Saginaw and Chicago plus handling--a cost which includes a "normal" profit. For a producer nearer to Chicago, the differential would be less, but the same parallel movement in local cash prices would be expected.

A basis chart was derived from these prices as shown in Figure 6. The relationship with July futures was selected for this illustration. The Chicago basis is simply the difference between cash prices at Chicago and July futures. This difference was -22 cents per bushel at the beginning of

Figure 5

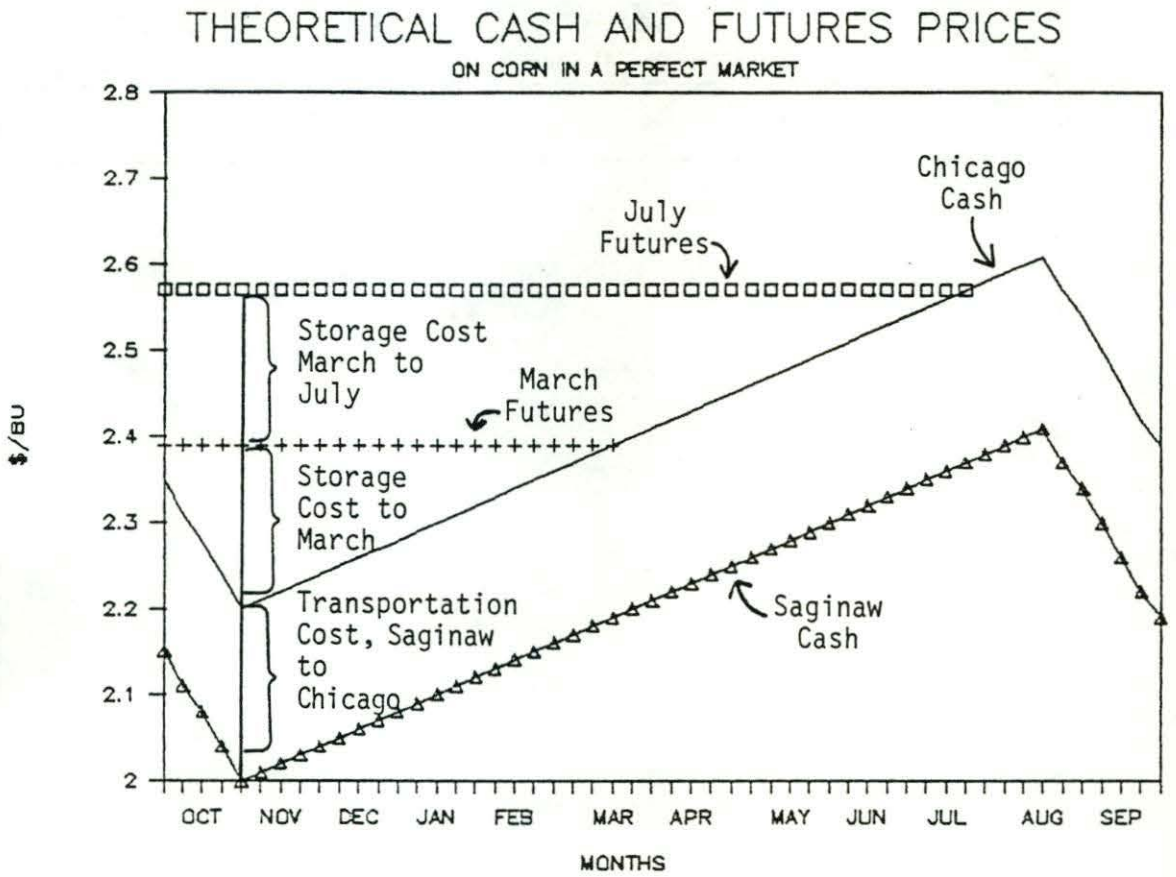
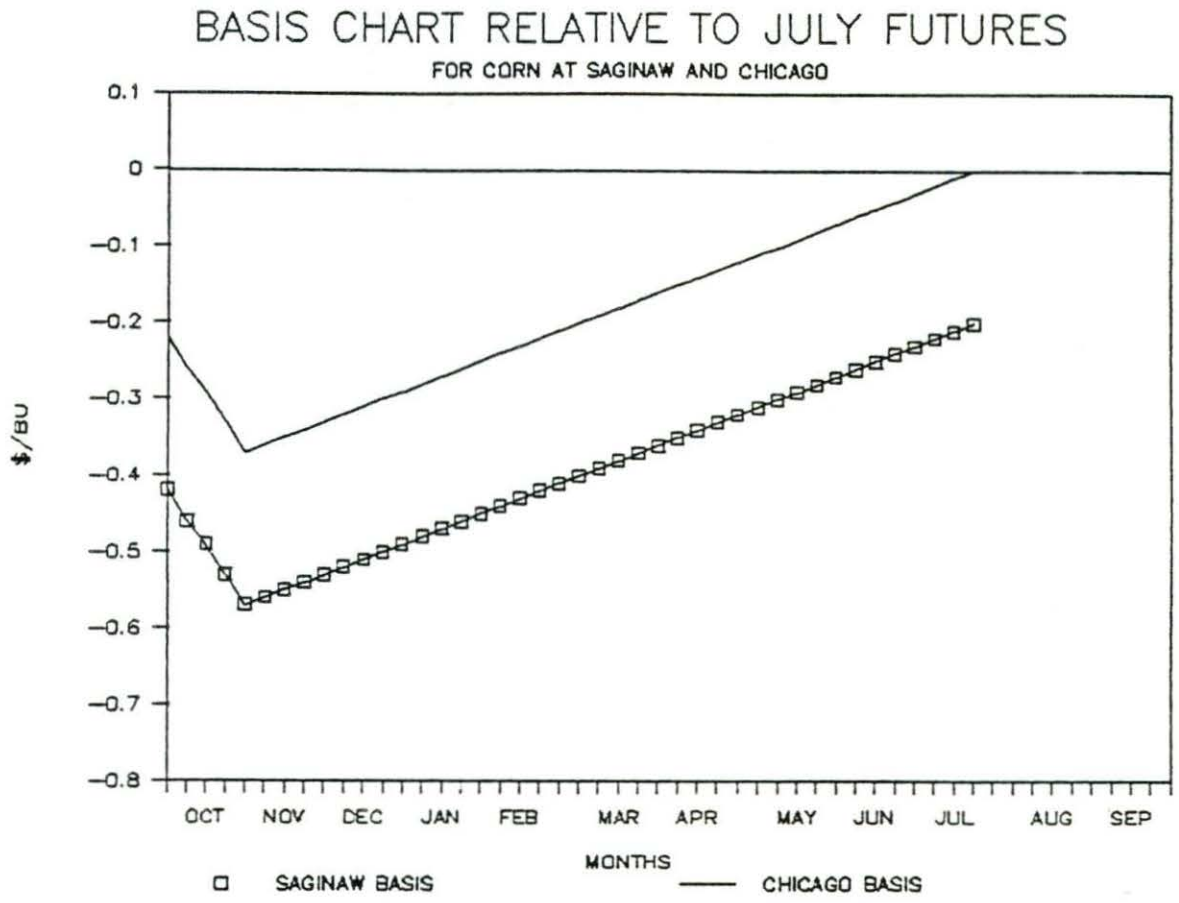

THEORETICAL CASH AND FUTURES PRICES
ON CORN IN A PERFECT MARKET
$/BU
2.8
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2
Chicago Cash
July Futures
Storage Cost March to July
March Futures
Storage Cost to March
Transportation Cost, Saginaw to Chicago
Saginaw Cash
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
MONTHS

Figure 6


BASIS CHART RELATIVE TO JULY FUTURES
FOR CORN AT SAGINAW AND CHICAGO
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
$/BU
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
MONTHS
SAGINAW BASIS
CHICAGO BASIS

October, declined to a low of -38 cents on November 1 and then increased linearly to 0 cents at delivery in the third week of July.

The Saginaw basis was parallel to the Chicago basis and 20 cents lower, reaching a low of -58 cents on November 1 and rising to -20 cents in July. The basis at Chicago and Saginaw "strengthened" or "narrowed" by 38 cents between November 1 and July.

In this "perfect" and riskless market, a farmer storing corn under a hedge would know exactly what the profit would be. With the Saginaw basis strengthening from $-.58 at harvest to $-.20 in July, the farmer would be assured of a gain of $.38 ($.58 - .20). If storage costs (including brokerage) were less than $.38, a profit would be assured. Of course, in a "perfect" market, the long-run adjustment between basis change and storage costs would be such that basis change would equal storage costs (including a normal profit).[1/]

The theoretical relationship between futures and cash prices is repeated in Figure 7, showing only July corn futures and Saginaw cash corn prices. Note that cash prices strengthen through the season at a rate equivalent to storage costs--sometimes called "carrying costs" or "carry." Cash prices reach the closest point relative to futures at delivery--the difference at that point being equal to transportation costs.

In Figure 8, actual July corn futures and Saginaw cash prices for the 1978-79 crop year are plotted on a chart with the theoretical levels in the background. Actual futures and cash generally followed the theoretical

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1/ Actually, in a "perfect" market, there would be no need for futures markets. Futures markets exist because of speculator interest in profiting from a change in price and the hedger's need to reduce risks of an unfavorable move in price.

Figure 7

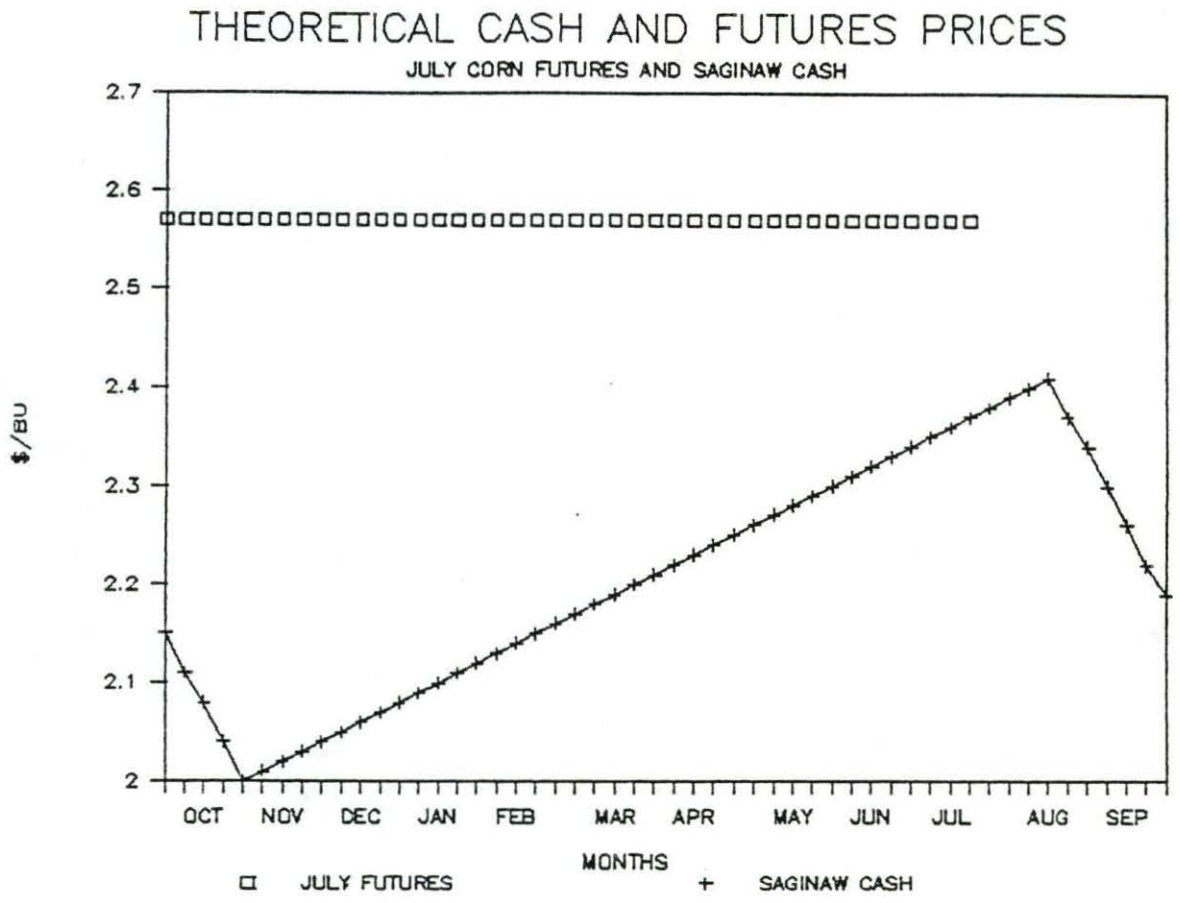
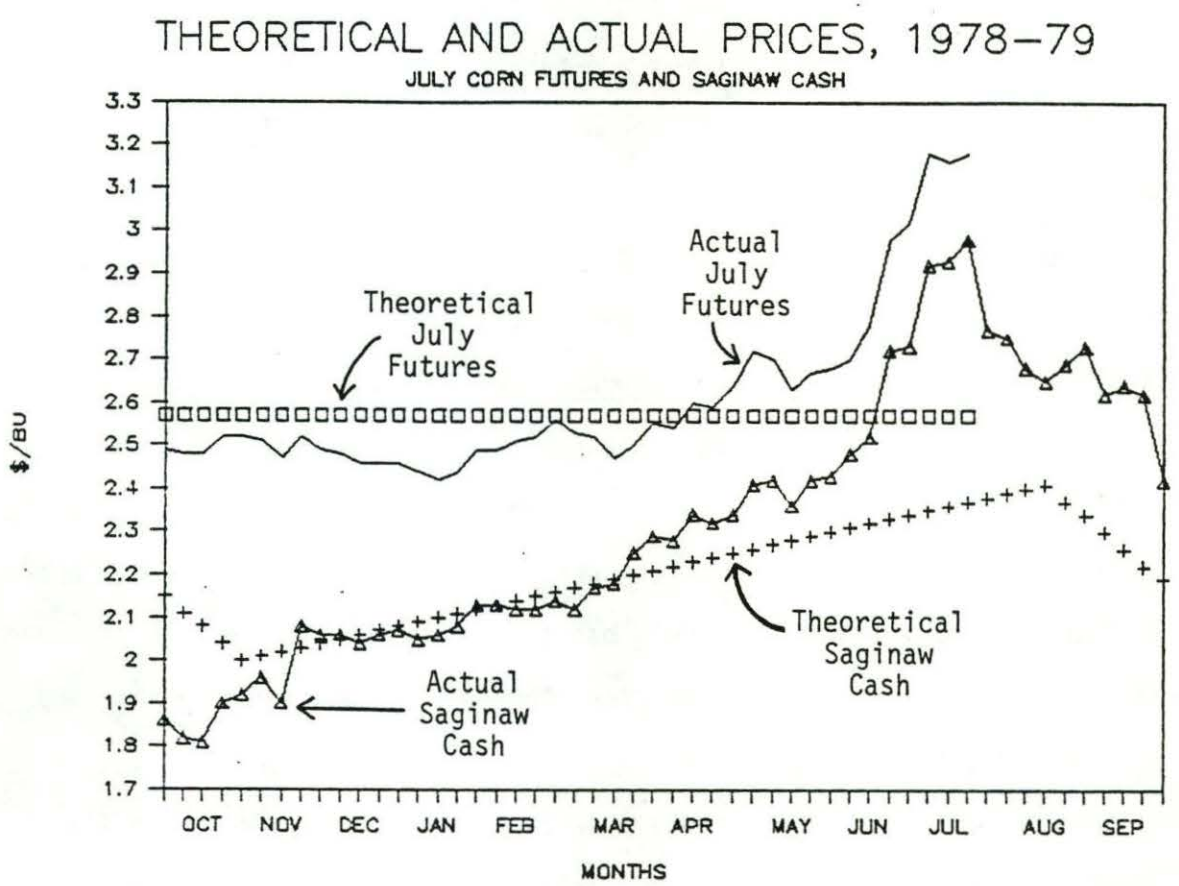

THEORETICAL CASH AND FUTURES PRICES
JULY CORN FUTURES AND SAGINAW CASH
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2
$/BU
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
MONTHS
JULY FUTURES
SAGINAW CASH

Figure 8


THEORETICAL AND ACTUAL PRICES, 1978–79
JULY CORN FUTURES AND SAGINAW CASH
$/BU
3.3
3.2
3.1
3
2.9
2.8
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2
1.9
1.8
1.7
Theoretical July Futures
Actual July Futures
Actual Saginaw Cash
Theoretical Saginaw Cash
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
MONTHS

pattern, but sprung to the upside late in the season. Note that movements in futures and cash were parallel and that the gap narrowed over the season. The narrowing or strengthening of basis is more clearly seen in Figure 9. Indeed, actual basis followed the theoretical basis very closely.

The price pattern for futures and cash prices was much different in 1979-80 (Figure 10). Basis was much weaker at harvest. The Russian grain embargo caused a noticeable aberration in January. Futures tended to weaken through most of the period. Even so, as shown in Figure 11, basis strengthened to levels above $-.30 by the end of the storage season.

Watching Basis Through the Storage Season

While determining at harvest whether or not to store under a hedge is an important decision, it is also advisable to follow basis throughout the storage season. This can be done by setting up a table or chart with entries about once a week. Not only should basis be plotted, but also some measure of whether basis offers opportunities for storage profits should be charted.

One suggested way to do this is to plot basis as illustrated in Figure 12. At the beginning of the storage season, prepare graph paper similar to Figure 12 with basis plotted on the vertical axis and weeks plotted in the horizontal axis. If July futures are to be used in hedging, place a point over the third week of July (delivery time) that represents normal basis for that week. In Figure 12, that basis is $-.20 at Saginaw, calculated from historical records. In the past five years, Saginaw cash prices have averaged about 20 cents under July futures in mid July.

If storage costs are at a flat rate--that is, so much per bushel per month--a farmer can easily plot what is called a "break-even" basis line. For example, assume a farmer is storing at a local elevator. Say the elevator is charging 3 cents per bushel per month and the additional cost to the farmer is

Figure 9

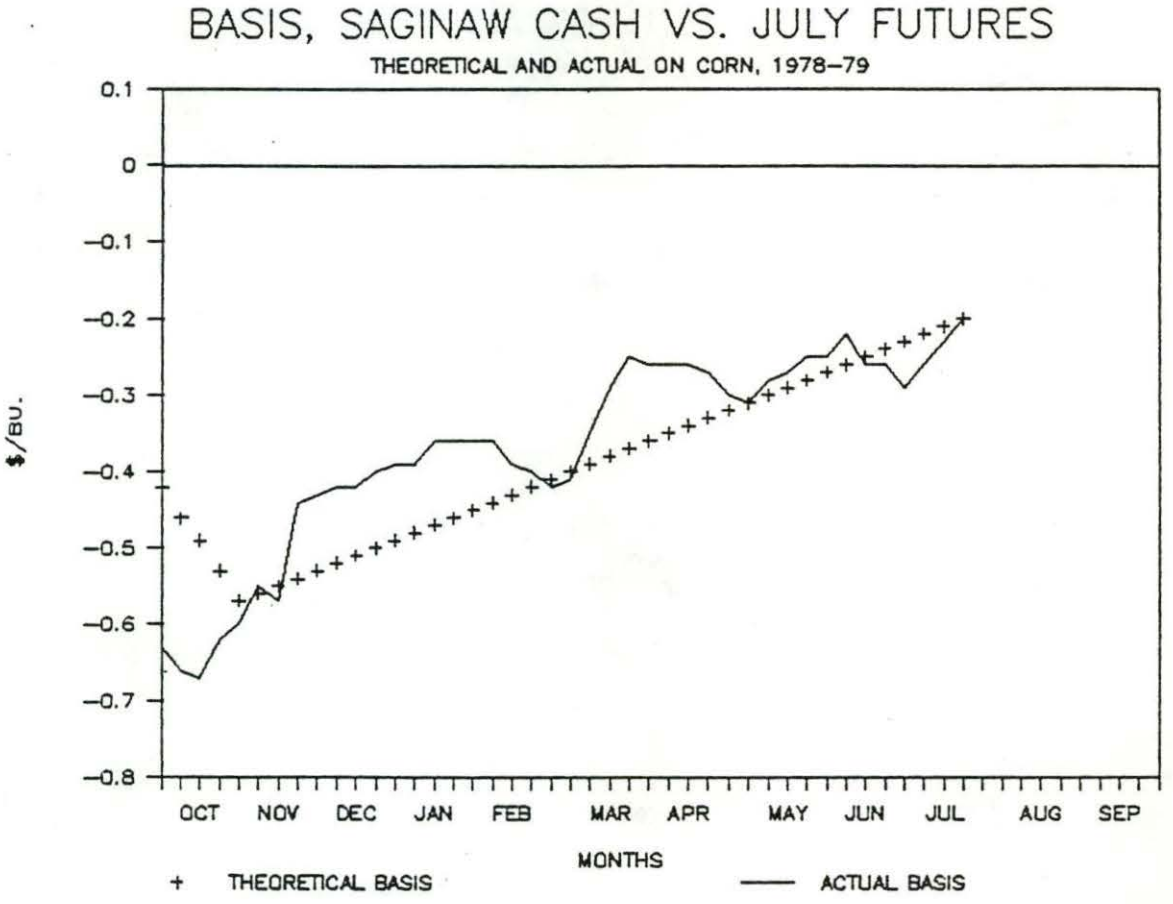

BASIS, SAGINAW CASH VS. JULY FUTURES
THEORETICAL AND ACTUAL ON CORN, 1978–79
0.1
0
–0.1
–0.2
–0.3
–0.4
–0.5
–0.6
–0.7
–0.8
$/BU.
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
MONTHS
+ THEORETICAL BASIS
ACTUAL BASIS

Figure 10

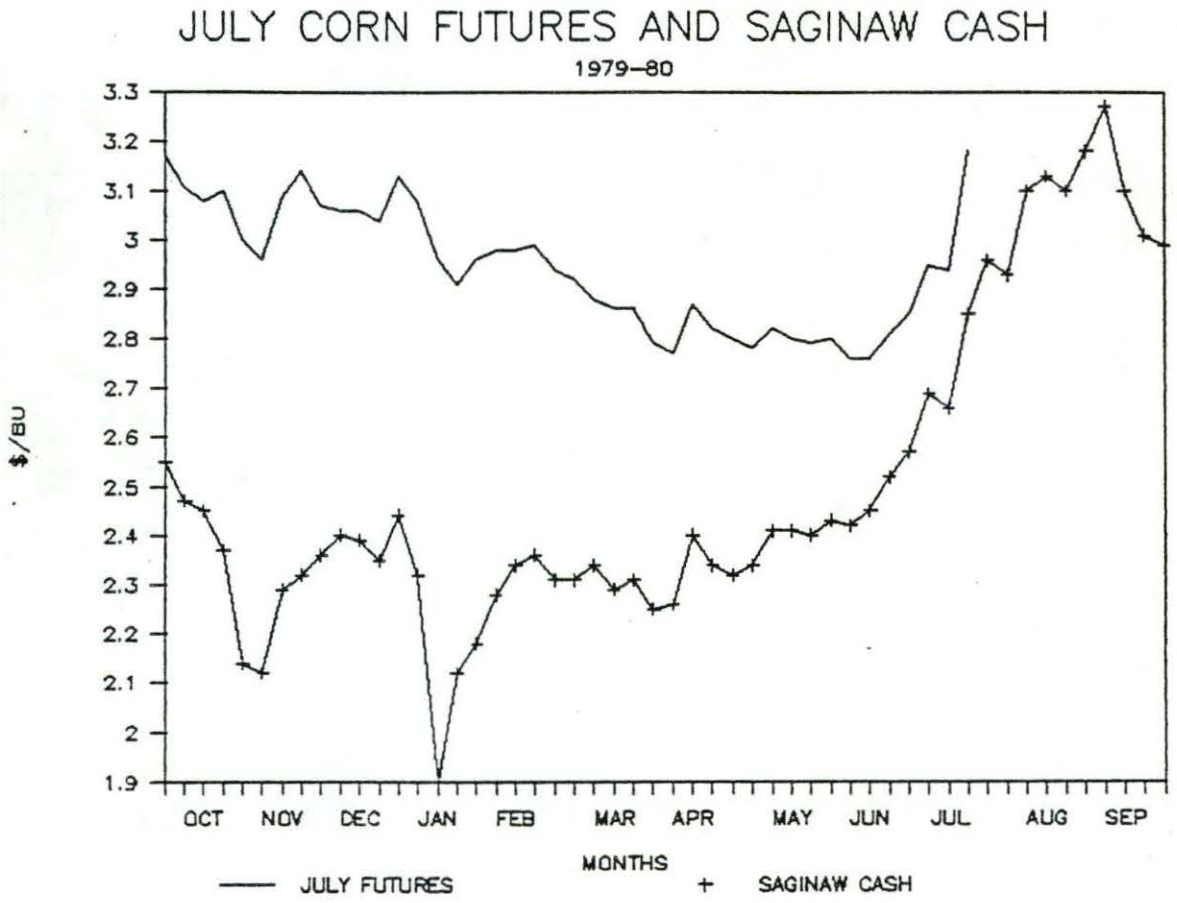

JULY CORN FUTURES AND SAGINAW CASH
1979–80
$/BU
3.3
3.2
3.1
3
2.9
2.8
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2
1.9
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
MONTHS
JULY FUTURES
+ SAGINAW CASH

Figure 11

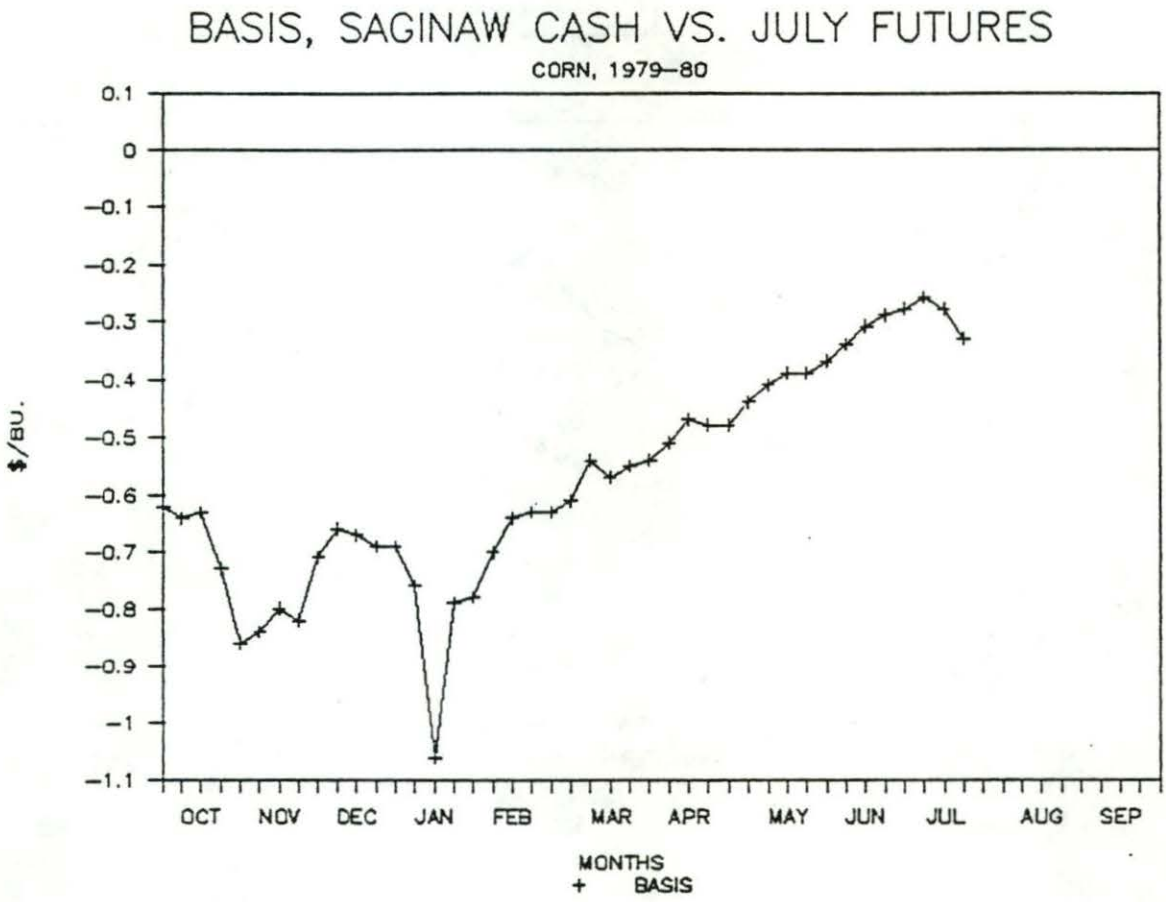
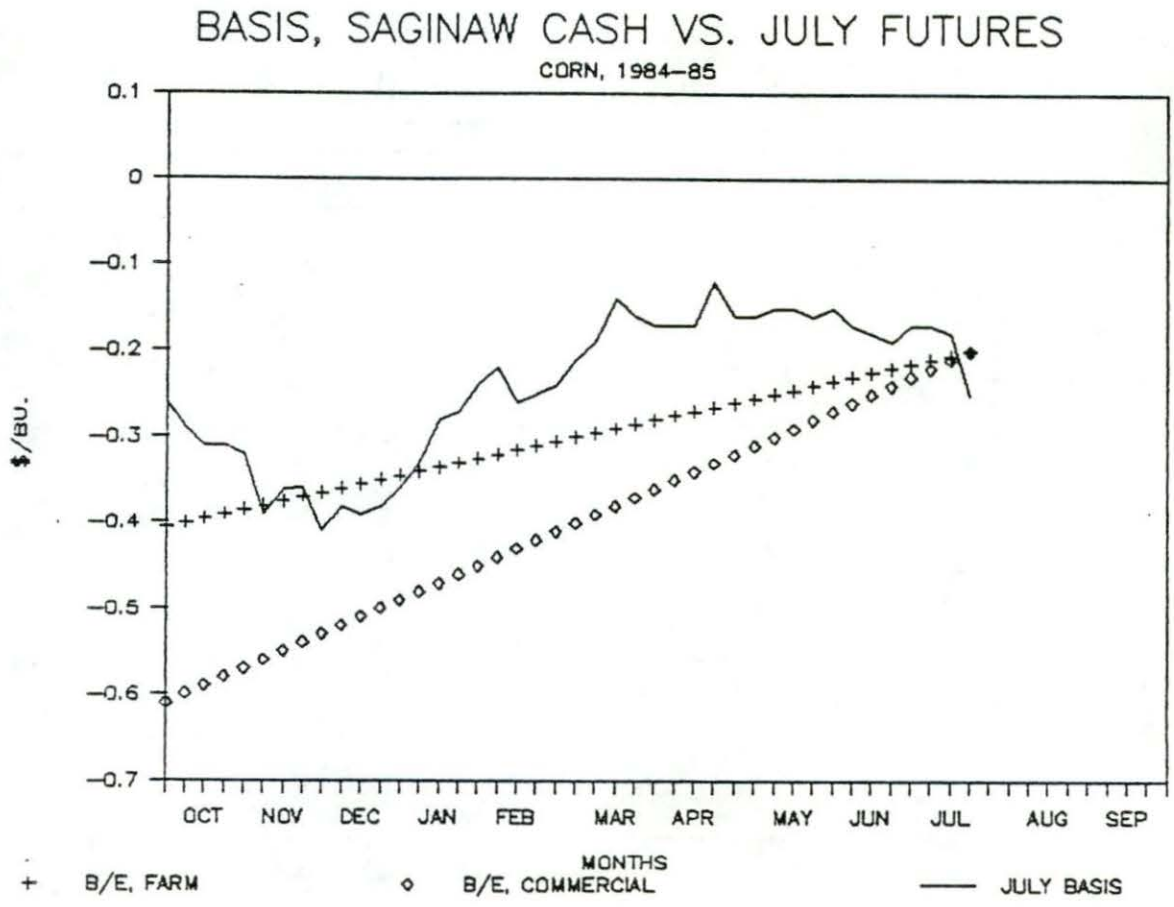

BASIS, SAGINAW CASH VS. JULY FUTURES
CORN, 1979–80
0.1
0
−0.1
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
−0.8
−0.9
−1
−1.1
$/BU.
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
MONTHS
+ BASIS

Figure 12


BASIS, SAGINAW CASH VS. JULY FUTURES
CORN, 1984–85
0.1
0
–0.1
–0.2
–0.3
–0.4
–0.5
–0.6
–0.7
$/BU.
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
MONTHS
+ B/E, FARM
◇ B/E, COMMERCIAL
—— JULY BASIS

foregone interest on the stored grain. Adding this cost would bring total costs up to nearly 5 cents per bushel per month or about 1 cent per bushel per week. Between the first week of October and the third week of July is a time span of 42 weeks. Storing from the first week of October to the third week of July would cost the farmer 42 cents per bushel. Deducting 42 cents from the -20 cent basis in July equals -62 cents. The -62 cents ($-.62) was plotted on the vertical axis at the beginning of October in Figure 12. Drawing a straight line from that point to -20 cents in the third week of July provides an important guideline for hedging--a break-even basis line.

At any time that actual basis falls below the break-even basis line for storing at the elevator (B/E, Commercial), a farmer knows that chances are favorable for a profitable hedge paying commercial storage rates. If that happens, the break-even basis line will also help the farmer decide when to lift the hedge. Once hedged, the hedge should be held until the actual basis rises above the break-even basis line--or if it doesn't, chances are that actual basis will be near break-even basis toward the end of the storage season.

In the example in Figure 12, for the 1984-85 crop year, actual basis did not drop below the commercial break-even basis, so the farmer should not have hedged. For other reasons, the farmer may have decided to store the crop, but should not consider hedging.

Farmers with on-farm storage have lower direct costs of storage. In the example in Figure 12, on-farm storage costs were estimated at 1/2 cent per bushel per week. At this rate, the break-even basis was $-.41 in early October (- 20 cent basis in July - 21 cents storage cost). A line was drawn from this point to -20 cents in the third week of July.

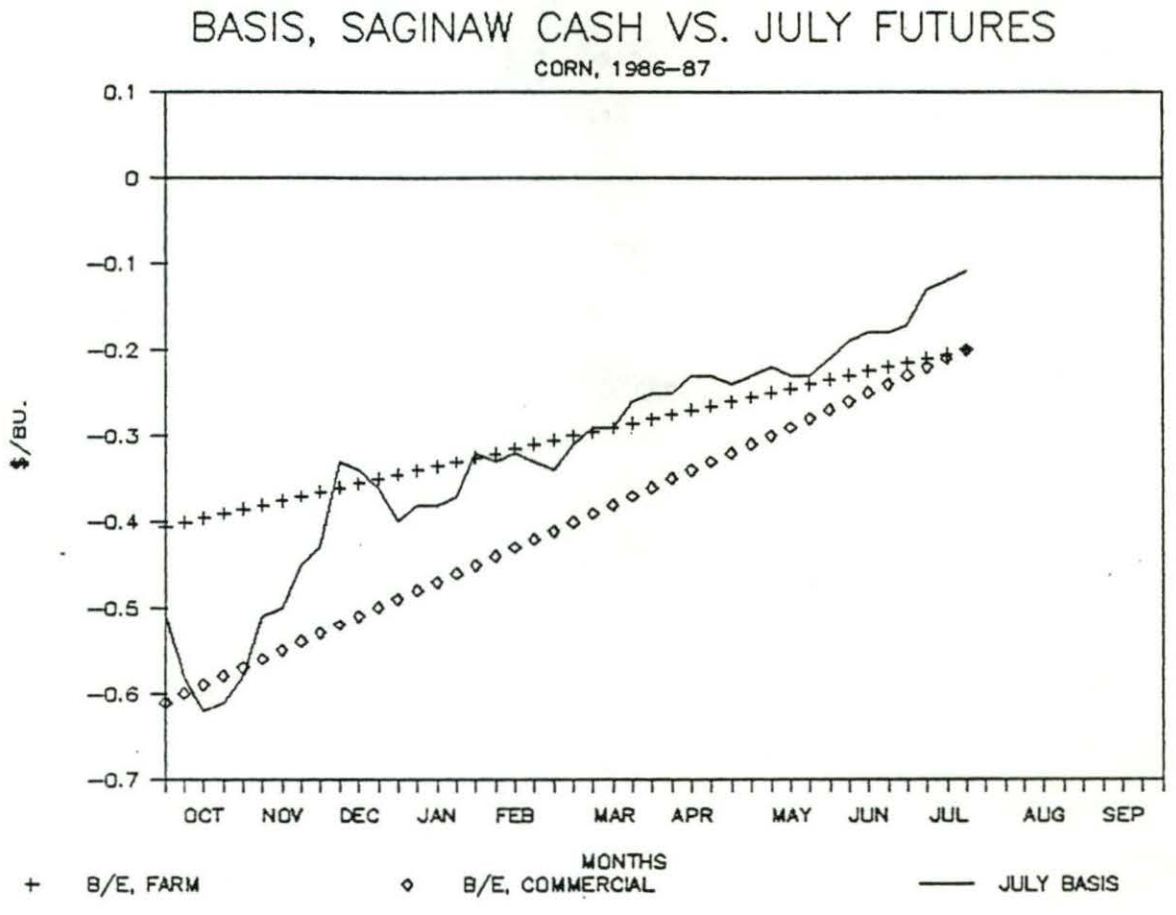
Actual basis did drop below break-even basis in late November and early December 1984. A farmer could have considered hedging at that time. Because of initial costs related to extra drying and handling, a rule of thumb is that actual basis should be at least 5-10 cents under break-even basis before hedging corn stored on the farm should be considered. But after the hedge is placed, the break-even basis line is a good indicator of when and if a hedge should be lifted. A farmer who would have hedged in this example could have profited the most by lifting the hedge in March or April. At that time, actual basis was the highest relative to break-even basis.

This type of chart is useful to farmers whether or not they hedge. A strong basis is a signal to farmers that the trade wants their grain. A weak basis is a signal that the trade is trying to encourage farmers to hold back sales. The basis chart provides a picture of these changing situations.

Consider the situation also where a farmer is optimistic and has decided to store grain for later sale. By watching the pattern emerging on the basis chart in Figure 12, the farmer would wisely sell cash grain along in March or April and buy futures (or maybe calls). Buying futures would not assure profits, but the prospective gains would be greater or losses less than holding cash grain.

In the 1986-87 crop year, basis was quite weak at harvest and then strengthened quickly as illustrated in Figure 13. Hedging would have been profitable for a farmer with on-farm storage and even for one paying commercial storage at the peak of harvest. The farmer storing commercially would have done well to lift the hedge in December. For the farmer with on-farm storage, no clear mandate to lift the hedge emerged until the end of the storage season.

Figure 13


BASIS, SAGINAW CASH VS. JULY FUTURES
CORN, 1986–87
0.1
0
−0.1
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
$/BU.
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
MONTHS
+ B/E, FARM
◇ B/E, COMMERCIAL
—— JULY BASIS

Use of Basis in Storage Strategies

To emphasize the value of basis information in storing crops, two storage strategies were analyzed on corn for the crop years 1973-74 to 1984-85. Saginaw cash prices to farmers were the focal point of the study. One alternative was to store each year on the farm and sell regularly from January to June. Seasonal price data indicated that this was the period of greatest promise for profits over storage costs. This alternative was called the "Cash Strategy."

Another alternative, called the "Cash/Hedge Strategy," involved some simple rules of thumb, incorporating basis and government loan rates. The rules were (1) sell at harvest if basis is no more than 6 percent under break-even basis; (2) store unhedged corn if the harvest price is more than 5 percent under the government loan and sell regularly from January to June; and (3) otherwise, hedge by selling July futures and lift the hedge whenever the basis exceeds the break-even basis by at least 2 percent of the cash price.[2/]

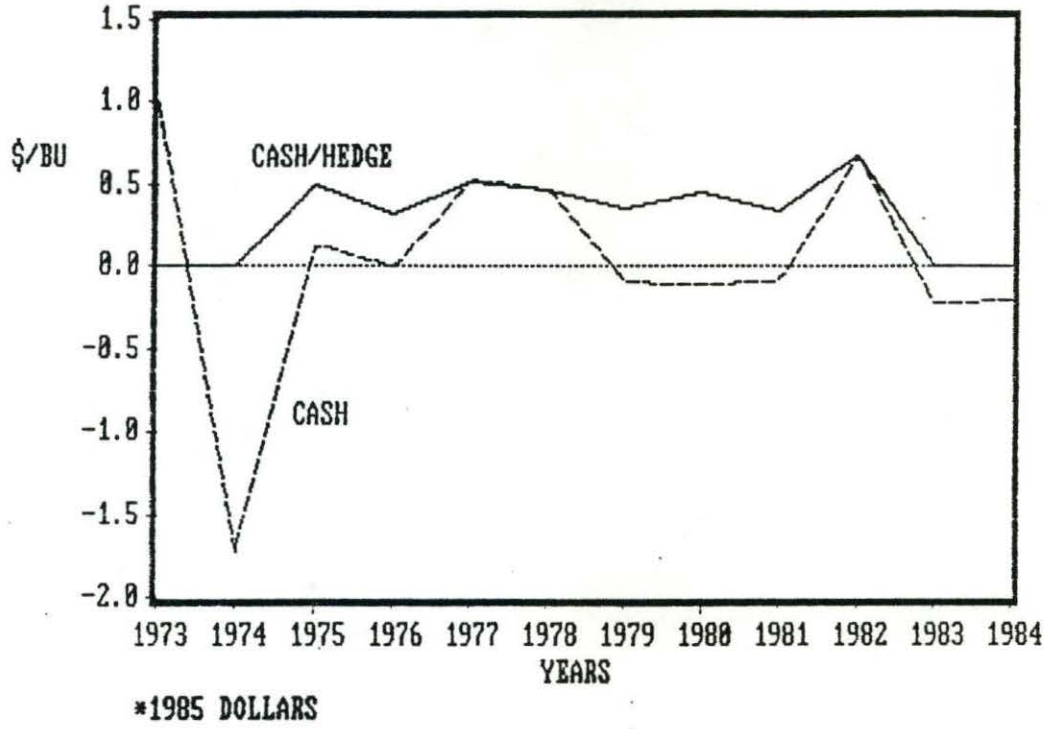
Net returns from the two strategies were measured in terms of net profits over cash sales at harvest. The returns were net of on-farm storage costs. These returns were then converted to 1985 dollars.

The results of the two strategies are illustrated in Figure 14. In 1973, the Cash Strategy netted about $1.00 per bushel, while the Cash/Hedge Strategy called for cash sale at harvest and thereby the net was zero. Cash sale at harvest was also the call from the Cash/Hedge Strategy in 1974, a year the Cash Strategy lost $1.75. Note the following:

[2/] In 1980-81, initial hedge was in March futures which was "rolled over" into July futures.

Figure 14

NET RETURNS PER BUSHEL ON CASH VS CASH/HEDGE STORAGE STRATEGIES ON CORN AT SAGINAW, 1973-74 TO 1984-85 CROP YEARS*



*1985 DOLLARS

1. Only in 1973 did returns from the Cash Strategy exceed the Cash/Hedge Strategy.
2. The Cash/Hedge Strategy never resulted in losses relative to harvest sale.
3. The average return from the Cash/Hedge Strategy was greater than the Cash Strategy over the 1973-84 period.
4. The year-to-year variability in returns was less with the Cash/Hedge Strategy.

If you can find or develop a strategy which out-performs other strategies in terms of both profit and variability of returns, you have a winner. Such strategies are not always easy to develop. However, the same analysis was applied to soybeans and white wheat with similar results. This underscores the importance of understanding basis and how to use this information in forward pricing.