

Markets and Price Determination

Agricultural Market Structure for Storable Commodities

Farm level prices for agricultural commodities have become much more volatile in recent years as a result of changes in government farm programs and international trade arrangements. Volatility refers to how much a price changes from one period to the next. For example, if corn prices are moving between \$2.00 per bushel and \$2.10 per bushel over some period of time, they are less volatile than if they range from \$1.85 per bushel to \$2.50 per bushel. The more volatile prices are, the more price risk there is in the market. In other words, the more likely a producer who is not employing a sound marketing strategy is to receive a price that is unacceptable. Marketing at the farm level is focused on minimizing price risk and insuring a profitable outcome.

Assume you produce 30,000 bushels of corn. If you average \$2.00 per bushel your gross return to corn production would be \$60,000. However, if you could average \$2.20 per bushel, your gross revenue would increase by \$6000, or 10 percent. If you could average \$2.60 per bushel, your revenue would increase \$18,000. A lot of corn is sold each year for \$2.00 or less per bushel, yet there are times during the year when prices are substantially higher. While most producers put significant effort into maximizing yield potential, the return to a little marketing effort is often greater than the return from increasing yields by a few bushels per acre.

In recent years, the U.S. grain marketing system has grown more complex. Industrial use of grain products has grown, but international competition has also increased. Government programs have increased planting and marketing flexibility, but also reduced the level of income support provided. Many of the factors which influence farmer prices take place great distances from the farm, and an astute marketer needs to learn what these factors are and how they may influence price.

Grain is produced in an annual production cycle. One of the functions of the grain marketing system is to allocate production over an entire year of consumption. Further, grain tends to be produced a significant distance from major consumption areas. The grain pricing system must encourage movement of grain away from the production areas and into the areas of major consumption (areas of large population).

Grain Price Formation

Figure 1 depicts the current U.S. grain marketing system. The pricing system in U.S. grain markets establishes values at the various stages of the marketing channel, from the farm to the export market. It provides incentives and signals for grain movement into different uses and different geographic locations. A central feature of the pricing system is the futures market.

Understanding futures markets is critical to developing an astute marketing program. The entire food marketing system relies on futures markets to determine prices paid to suppliers and charged to customers. Most pricing opportunities grain producers face are influenced by price action in the futures market.

There are lots of futures exchanges in the U.S. and around the world. For our purposes, however, we are going to focus on grain contracts traded at the Chicago Board of Trade. This is where corn, soybeans, and soft red winter wheat are traded.¹

¹ Oats also trade at the Chicago Board of Trade, and there are wheat contracts traded in Minneapolis and Kansas City. However, they are for different classes of wheat. The Kansas City wheat contract, for example, is for hard red winter wheat. In general, futures exchanges offer unique contracts, meaning that the same commodity does not trade at two different exchanges. One exception, however, is in the dairy sector. Nearly identical milk futures contracts are traded at the New York Commodity Exchange and the Chicago Mercantile Exchange (which is not associated with the Chicago Board of Trade).

Figure 1.

<p>LOCAL ELEVATOR:</p> <ul style="list-style-type: none">Grade GrainCondition GrainStore GrainReveal the first public price for grain
<p>SUBTERMINAL ELEVATOR:</p> <ul style="list-style-type: none">Linked to local elevator by rail, barge, or truckOften do not buy directly from farmersMajor function is to concentrate grain into large shipmentsReveal second public price for grain.Basically the local elevator price plus transportation and handling costs.
<p>TERMINAL ELEVATOR:</p> <ul style="list-style-type: none">Sell to export markets and processors. Do not buy from farmers.Reveal third public price for grain.Sub-terminal price plus transportation and handling costs.
<p>EXPORT TERMINAL ELEVATORS:</p> <ul style="list-style-type: none">Very concentrated industry. Over half of the U.S. export capacity is owned by Cargill, Bunge, and Louis Dreyfus.Offer the export price to compete in the international market.

Futures Markets

Futures markets for U.S. produced grain were initially developed in the 1860's with the establishment of the Chicago Board of Trade.² Since the 1970's, volume of trade in futures markets has increased significantly, and the types of products traded have grown. Futures contracts on livestock were developed at the Chicago Mercantile Exchange beginning in the 1960's, and contracts on non-agricultural products have also developed over the last 30 or 40 years.

A commodity futures contract is a legally binding commitment calling for the holder of the contract to either deliver or accept delivery of a commodity at a specific price, on a

² The concept of futures trading dates back several thousand years. However, the Chicago Board of Trade is the oldest futures exchange currently in existence. It began trading modern futures contracts in October 1865. For a complete discussion of the history of futures markets, see "Starting Out in Futures trading", by Mark Powers.

specific future date, at a specific location. Futures contracts can initially be either bought or sold. If you sell a futures contract, you go short the market. This means you take on a legal commitment to deliver the commodity specified in the futures contract on the date the contract matures.³ Since the futures contract requires delivery at some later date, it is possible to sell something in the futures market that you do not physically have. This is not unique to futures markets, however. A car dealer could agree to sell you a pickup truck for delivery in August 2000 even though he does not yet have the truck on his lot. He would be taking on a legal commitment to deliver a truck to you in August, at a specific price, and with specific options.

One unique feature of futures markets is that futures contracts are traded on margin. Margin requirements in futures markets are generally very low. Many margin requirements are 8 to 10 percent of the value of the futures contract, but sometimes margins are as low as 1 percent of a futures contract's value. There are really two separate margins involved in futures transactions. The first is called the initial margin. This is the amount of money a trader must have in a futures trading account in order to initiate a position in the futures market. In the corn example above, the initial margin was \$500. If I choose to buy or sell corn for July delivery today, I must post at least \$500 in my margin account (the margin account will be held by my broker). If I buy corn, and the price by the end of the trading day is 2 cents per bushel less than where I bought, then I have lost 2 cents times 5000 bushels, or \$100. My account will be debited \$100 at the end of the day, and anyone earning a profit from the price of corn going down (those who had earlier sold corn for July delivery) would be credited with profits. Those earning profits could withdraw all monies in excess of the \$500 initial margin at the end of the day if they so chose.

The second type of margin involved in futures trading is the maintenance margin. The maintenance margin is generally less than the initial margin (there are rare circumstances where the maintenance margin may equal the initial margin), and it represents the minimum value a trader's account must have before the trader is required to deposit additional funds to his/her trading account in order to maintain a futures position. Assume in the corn trading example that the maintenance margin is \$350. When I bought corn and incurred a 2 cent per bushel loss after the first day, the value of my account fell from \$500 (the initial margin) to \$400. While \$100 was deducted from my account and placed in the account of a trader who profited from the 2 cent price decline, I was not forced to put additional money in my trading account because its value was still above the maintenance margin of \$350. However, if I incurred another 2 cent per bushel loss on the next trading day, my account value would fall to \$300. At this point I would be required to make a deposit to my trading account, and restore its value to the full initial margin amount. If I failed to do so, my position would be liquidated and I would no longer have a futures position.

When an additional deposit is required to return the account value to its initial margin amount, the trader faces what is called a margin call. Technically, all margin calls are

³ In reality, the delivery date for a grain futures contract actually spans a period of almost three weeks. Actual delivery can happen anytime over the three-week period.

due by the opening of trade the following day. However, many brokerage firms give their customers two or three days to make a margin call. The exchange clearing house does not extend the same courtesy to the brokerage firms, so in essence the brokerage firm makes the margin call on the customers behalf and then waits for reimbursement.

Table 1 illustrates a trading account and its changing value as price changes. In the example, a trader bought 1 July corn contract at \$2.50 per bushel. The initial margin is \$500, and the maintenance margin is \$350. Remember that any amount above the initial margin can be taken out of the account at any time, but when the account value falls below the maintenance margin, a deposit sufficient to return value all the way to the initial margin is required.

Table 1. Margin Account Maintenance.

Date	Price per Bushel	Action	Margin Action	Account Balance
Initial margin = \$500 Maintenance margin = \$350				
17-Jan	\$2.50	Buy July corn	Deposit \$500	\$500
18-Jan	\$2.48			\$400
19-Jan	\$2.46			\$300
			Margin Call \$200	\$500
20-Jan	\$2.47			\$550
21-Jan	\$2.40			\$200
			Margin Call \$300	\$500
24-Jan	\$2.43			\$650
25-Jan	\$2.45			\$750
26-Jan	\$2.49			\$950
			Withdraw \$450	\$500
27-Jan	\$2.51			\$600
28-Jan	\$2.55	Sell July corn		\$800

Basis

Understanding Basis

Understanding the relationship between local cash prices and prices in the futures market is key to making any grain marketing decision. Even producers who never use the futures market directly benefit from understanding the relationship between their local market and the futures market.

The relationship between cash and futures prices is called the basis. Basis is simply the difference between the current cash price at a specific location and the futures price for a specific futures contract. The basis accounts for the difference in the supply and demand relationships in the local market relative to the futures market. It is usually calculated as CASH PRICE minus FUTURES PRICE.

As an example, consider the market for corn. Corn futures contracts trade for delivery in Chicago. Since Chicago is a grain deficit area (i.e., no grain is grown there, but there is demand for grain), Chicago's corn price will generally be above the price in a local market where corn is produced. This is because corn buyers in Chicago must be willing to pay the producer's local price plus transportation costs between Chicago and the local market to encourage corn delivery in Chicago. As a result, basis in grain surplus areas will generally be negative, meaning the cash price is below the futures price. For example, if the futures price for December corn (that is, a futures contract for corn to be delivered in December) is \$2.30 per bushel, and the local cash price is \$2.00 per bushel, the basis is $-\$0.30$ (cash price minus futures price).

In addition to transportation costs, storage costs influence basis levels. Assume the date is February 1, and corn in your local market is \$2.00 per bushel. Also assume that corn futures contracts for March delivery are trading for \$2.20 per bushel. The local basis would be $-\$0.20$ relative to the March contract. In most years, the July contract for corn would be trading at a higher price than the March contract; let's say \$2.40 per bushel. The July contract is at a premium over March because it will cost more to store corn from February to July than from February to March. Since there will be no new supply of corn between February and July, the only way to insure corn will be available in July is for market participants to be willing to pay corn suppliers the current market price plus expected storage costs between February and July. If the July price did not compensate for storage costs there would be no incentive to store corn, and thus no assurance of a supply of corn in July.

Notice in the above example the February basis differs depending on which futures contract one considers. Relative to March futures, the basis is $-\$0.20$. Relative to July futures the basis is $-\$0.40$.

A basis in which the cash price rises *relative* to the futures price is said to be strengthening. In other words, the higher the cash price for any given futures price, the

stronger the basis. Thus, a basis of $-\$0.10$ is stronger than a basis of $-\$0.20$. If the cash price begins to fall *relative* to futures, the basis is weakening.

In general, we expect the basis in a grain producing area to strengthen as we move away from harvest. This is because the local market is slowly reducing its overall relative excess supply of grain. Consider a March futures contract for corn that has a price of $\$2.10$ per bushel in November. As we move from November into December and January, we generally would expect the cash price to start moving up towards the March futures price even if the March futures price stays around $\$2.10$. The local basis is strengthening as grain is moved out of the local market. This is an important concept. One way to make money on storage is to realize a strengthening basis over the storage period., i.e. cash prices strengthen even if futures markets do not rally. An important part of deciding whether to store grain is determining if there are opportunities for the local basis to strengthen, and whether the expected improvement in basis will be sufficient to cover storage costs.

Since basis is largely determined by transportation and storage costs, several observations can be made. First, basis is likely to be weaker the further a country elevator is from the Chicago market, or some other terminal market. The further from a terminal market, the lower the cash price will usually be relative to futures prices. In general, Wisconsin basis levels will be weaker in the central part of the state than they are in the southeastern corner or on the Mississippi River. This is because excess grain production in central Wisconsin must be moved to the Milwaukee/Chicago corridor, or to the river in order to enter the commercial marketing channel. This transportation cost results in lower cash prices relative to markets located near larger terminals.

Also, basis will tend to be weaker than normal in local markets when storage facilities are glutted and handling and transportation equipment are strained to capacity during a bumper harvest. Conversely, a short crop locally will result in a stronger than normal basis at harvest since there is less relative excess supply than occurs in most years.

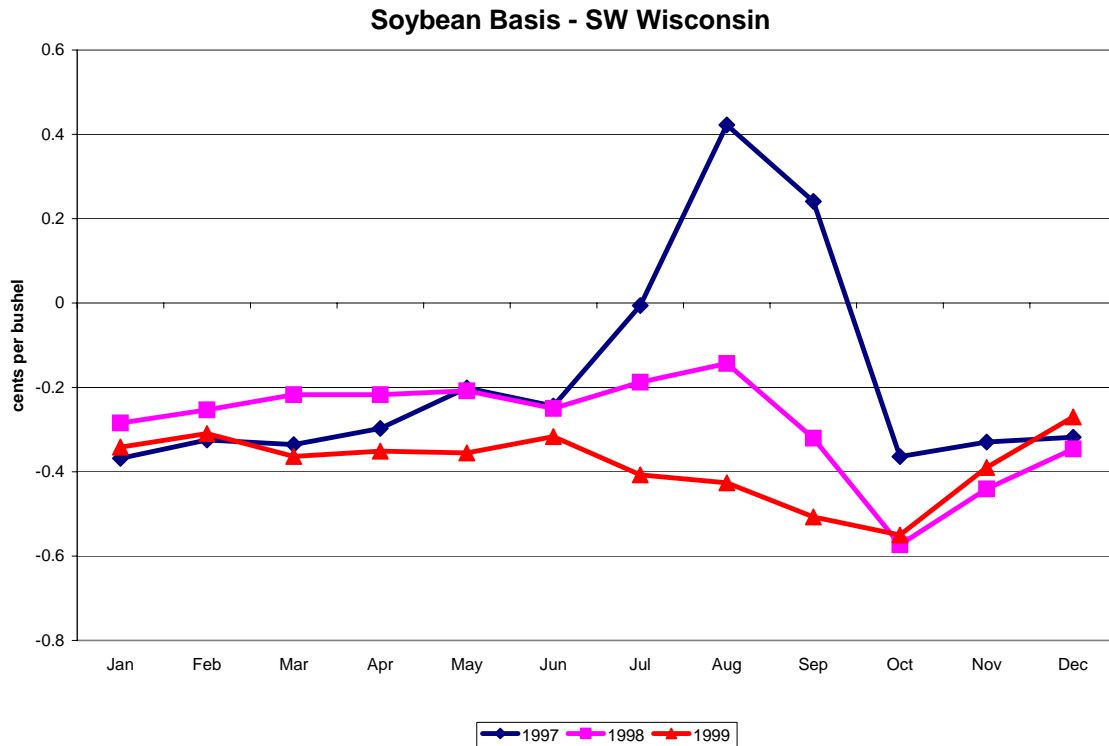
Last, since the largest supply of the year occurs right at harvest, we would expect the weakest basis of the crop year to occur at harvest. As supplies diminish, basis will generally strengthen until the next harvest.

An illustration of soybean basis for Southwest Wisconsin is given in Figure 1. Note that while basis varies across years, it does tend to exhibit a similar pattern of movement each year. Further, while it varies significantly in the summer months from year to year, it does tend to end each year at about the same level. This is important to know. The less the basis varies from year to year, the less basis risk exists. In Figure 1, basis risk is greatest in August (there are the greatest differences from year to year in the August basis), while basis risk is small in December (the basis only varies a few cents per bushel from year to year).

Forecasting Basis

In order to use basis information to improve cash marketing decisions, it is important to predict what the basis will likely be in coming months. For grains, this can be done

Figure 1.



relatively simply. The most common forecasting strategy is to simply use the average basis experienced in previous years.

In order to keep basis recording efforts to a minimum, most people simply track the average monthly basis over time. Tracking the basis over the last 3 to 5 years, and averaging each month's basis across years is the simplest method. This average is then used as a forecast of basis in the coming year.

Remember that basis is the cash price minus the futures price. In general, the only basis we care about tracking is the local cash price minus the futures price for the contract closest to maturity. So, for example, the corn basis in January is the average January cash price minus the average price in January for the March futures contract (this is the contract closest to maturity in January as there is no corn contract for February delivery). In February, the basis is the average February cash price minus the average price in February for the March futures contract.

The March futures contract will expire about the third week of March. Traders who do not want to make or take delivery of corn in Chicago in March will be scrambling to

offset their delivery obligations the last couple of weeks the contract trades. As a result, the March contract in March becomes less useful as a pricing reference. Therefore, the basis in March is the average March cash price minus the average price in March for the next futures contract. The next corn contract is for May delivery, so the March basis is the cash price minus the price in March for the May futures contract.

In order to calculate the monthly average basis, it is only necessary to collect prices once a week. The best day is usually Wednesday because it is in the middle of the work week, so futures traders are just trading the current set of information, not trying to make up for information which became available over the weekend (as happens on Monday) and not attempting to adjust their obligations to minimize risk exposure over the next weekend (as often happens on Friday). The relevant futures price is the last price traded each Wednesday. This is the price that represents the market consensus of value at the end of the trading day.

To calculate the basis, collect the closing futures price on Wednesday, and then collect the cash price from the local elevator either late Wednesday afternoon or first thing Thursday morning. Most elevators change their cash price bids about 2:00 PM each day following the close of futures trading (the grain markets close at 1:15 Central Standard Time). Make sure the cash price collected has been adjusted for the most recent closing futures price.

Subtracting the futures price from the cash price each Wednesday gives the basis for a given week. While it may vary a little from day to day, once a week will generally be accurate enough. If there are four Wednesday's in a given month, the basis from each of the four Wednesday's is averaged, and this gives the average basis for that month in that year. If this is collected and calculated for three years in a row, then the average of the three years gives the expectation for the basis in the coming year.

Table 1 provides an illustration. Each month's basis level for each year is the average of every Wednesday's basis each month. The forecast for 2000 is the average of each month's basis from 1997, 1998, and 1999.

Table 1. Southwest Wisconsin Soybean Basis.

	Jan	Feb	Mar	Apr	May	Jun	Jl	Aug	Sep	Oct	Nov	Dec
1997	-0.37	-0.32	-0.34	-0.30	-0.20	-0.24	-0.01	0.42	0.24	-0.36	-0.33	-0.32
1998	-0.28	-0.25	-0.22	-0.22	-0.21	-0.25	-0.19	-0.14	-0.32	-0.57	-0.44	-0.35
1999	-0.34	-0.31	-0.36	-0.35	-0.36	-0.32	-0.41	-0.43	-0.51	-0.55	-0.39	-0.27
2000 Forecast	-0.33	-0.30	-0.31	-0.29	-0.26	-0.27	-0.20	-0.05	-0.20	-0.50	-0.39	-0.31

Using Basis to Improve Storage Decisions

An important use of local basis information is improving the quality of storage decisions each year. If a producer has a good feel for how basis levels change through the year in

his/her local market, this information can be combined with current futures prices to decide whether storage is an attractive strategy in the local area.

The difference between two futures prices for different delivery months represents a measurement of the national average return to storage. For example, if the March corn contract is trading for \$2.50 per bushel, and the May corn contract is \$2.60 per bushel, the national market (as measured by Chicago futures prices) is offering 5 cents per month for storage between March and May. However, this does not mean that the local market is paying the same return to storage. By using basis patterns to localize each futures price, however, the local return to storage currently being offered can be estimated.

Using the basis forecasts from Table 1, note that in February the Southwest Wisconsin cash price for soybeans is expected to be about 30 cents under the March futures price (the contract closest to maturity in February). If March soybean futures are trading today for \$5.20 per bushel, then the current expectation for the February cash price is \$4.90 (the March futures price adjusted for the average basis in February). A producer can compare this price with the price they would get if they sold soybeans locally today. If the difference between today's local price and the expected cash price in February (\$4.90 per bushel) is more than the costs of storage⁴, market conditions indicate that it is currently expected that storage in the local market will be profitable at least until February. By looking at expected basis and current futures prices for other delivery months, the producer can decide how long the market is expected to pay for storage, and thus the optimal month, given current market information, to sell the stored soybeans. Without a good basis forecast, storing soybeans is more risky because the producer can not determine an expected cash price for later sale to compare to today's cash price.

If the combination of basis expectations and current futures prices result in expected cash prices in later months that do not exceed the current price by more than the costs of storage, the market is telling producers that it would rather buy their soybeans today, and will actually charge them to hold them off the market for later sale. Under this scenario, the only way a producer will profit from storage is if there is an unexpected rally in the futures market, and the cash market follows (i.e., the basis does not weaken as futures prices rise). While this is always a possibility, it is much more risky to store cash grain betting just on a futures rally than to store grain when the combination of expected basis and current futures prices are already rewarding storage through higher expected cash prices in later months.

Table 2 illustrates how a producer would analyze a storage decision using all available market information. Assume the current date is January 15, and the cash price offered for soybeans today is \$4.75 per bushel. What the producer wants to know is whether he/she should sell soybeans today, or continue storing them.

⁴ Producers should assume that the minimum cost of storage is 3.5 cents per bushel per month, even if they own their bins and they are paid for. Producers renting commercial storage space will sometimes pay up to 5 cents per bushel per month.

From Table 2 we can see that the market is paying an excellent reward for storing from mid-January to February. Even if the futures market does not rally, we would expect to make 15 cents per bushel after storage costs have been subtracted. The one risk is falling

Table 2.

Using basis information to evaluate a storage decision.

January 15, 2000

Today's cash price	\$4.75
March futures price	\$5.23
May futures price	\$5.32
July futures price	\$5.41

Expected cash prices for later delivery on January 15:

Store Until:	February	March	April	May	June
Futures Price	\$5.23	\$5.32	\$5.23	\$5.41	\$5.41
Expected Basis	-\$0.30	-\$0.31	-\$0.29	-\$0.26	-\$0.27
Expected Cash Price	\$4.93	\$5.01	\$5.03	\$5.15	\$5.14

Storage Return

Expected Cash Price	\$4.93	\$5.01	\$5.03	\$5.15	\$5.14
minus Today's Price	\$4.75	\$4.75	\$4.75	\$4.75	\$4.75
minus Storage Costs*	\$0.035	\$0.07	\$0.105	\$0.14	\$0.175
Total Return	\$0.15	\$0.19	\$0.18	\$0.26	\$0.22
Per Month Return	\$0.15	\$0.095	\$ 0.058	\$0.065	\$0.043

* Storage costs are 3.5 cents per month.

make 15 cents per bushel after storage costs have been subtracted. The one risk is falling futures prices. If futures prices go down by more the 15 cents per bushel between January 15 and February, we could lose money. However, if futures prices either stay the same or go up, we will make money on storage.

If we continue storing from February to March, we make an additional 4 cents per bushel after storage costs are subtracted. Note from March to April, however, we actually expect to lose a penny a bushel. This is worth doing, though, if we can continue to store into May. After May, we start losing money on storage. Using our understanding of basis and the current futures prices, we have discovered that the local market is offering us the greatest reward for storing to May, but after May we will likely lose money on storage. Again, the only thing that will affect the outcome in a negative way is if futures prices fall during the storage period. As long as they don't fall by more than 26 cents per

bushel between January and May, however, we will still make at least enough to offset storage costs⁵.

⁵ This assumes we have made a good basis forecast. If basis turns out different than expected, it will also affect storage returns. From Table 1 we can see how much the basis for each month has varied over the years, so we do have some feel for the basis risk involved in making the storage decision.