



# Risk and Resilience in Agriculture

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## Understanding and Using Basis for Livestock Producer Marketing Management<sup>1</sup>

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This Fact Sheet will assist a livestock producer or feeder in understanding the importance of the basis when forward pricing livestock. Basis is defined, basis theory is examined briefly and basis is used in hedging examples.

Hedging is defined as the act of entering the futures market to gain protection against adverse price movements. The hedger always takes a position in the futures market opposite the position in the cash market.

### History and Background

The Chicago Mercantile Exchange is the largest exchange that trades livestock commodities. Futures trading for live cattle (slaughter steers) was initiated on November

30, 1964. Trading for live hogs (barrows and gilts) started on February 28, 1966. Contracts began trading on feeder steers on November 30, 1971. Slaughter cattle and slaughter hog options, which are options on the underlying futures contracts, were added on October 30, 1984 and February 10, 1985, respectively.

Basis data are used for both option and futures market analyses. Hedging examples used in this fact sheet will concentrate on the impact of basis on the livestock futures contracts as if the option had been exercised and the livestock producer or feeder is dealing with the futures market. Information about Agricultural Options is contained in North Central Regional Extension Publication #217. Fact Sheet #1, Agricultural Options.

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<sup>1</sup> NCR Extension Publication 217, Fact Sheet #5

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The livestock futures markets play an important role in helping producers minimize the risks of adverse price movements. An important part of using the futures market effectively is understanding the mechanics of trading. Understanding the basis and being able to forecast the basis is the bottom line of hedging. Historical basis data or basis patterns will allow a livestock producer or feeder to make better judgments about the expected relationship between the futures and the cash market for a given marketing date. In other words, historical basis data are used to make better estimates about the future relationship between the futures and the cash market. Livestock producers or feeders who want to forward price some or all of their sales need basis data to adjust the futures price to their local sale point. The adjusted futures price or the expected cash price then is used by the producer or feeder to decide to make or not make the forward pricing decision.

### Basis Definition

The amount by which the local cash market price differs from the futures price on any given business market day is called the basis. A basis pattern is a daily, weekly, monthly or other price series showing the difference (basis) between the futures and the cash prices for the past year or the past several calendar years. Many factors affect the basis—such as cash market location, transportation network and costs, grade, average weight, dressing percentage, shrinkage and other items. For livestock, basis data can be calculated for slaughter cattle, feeder cattle and slaughter hogs.

In this publication, all references to the basis are interpreted as the amount by which the cash price is above or below the futures price.

The computation of the basis is simply the cash price minus the futures price<sup>3</sup>. When cash prices are lower than futures prices, the basis is negative (a [-] sign on the basis amount). Conversely, a cash price higher than futures would yield a positive basis (a [+] sign on the basis amount).

Basis concepts apply to all livestock futures contracts. Basis and hedging information provided in this publication will generally use slaughter or feeder cattle in all examples, but the concepts would be the same for hogs.

### Basis Theory

There are three fundamental relationships that must hold for the futures market to provide a satisfactory means of hedging: (1) cash prices and futures prices must move generally in the same direction over time, (2) during the month in which a futures contract matures, the price of that futures contract and the price in the cash market at futures delivery points must come reasonably close together by a fairly predictable amount, and (3) for hedging in areas outside of futures delivery points the movements of the cash price in the delivery and non-delivery markets during the delivery period must reflect a fairly predictable difference over time.

On any given day, cash and futures price may move in opposite directions, but that is a temporary phenomenon. Basically, futures prices represent traders' expectations of future supply and demand conditions as deduced from current and anticipated prices. Both cash

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<sup>3</sup> In this publication the basis is calculated as the cash price minus the futures price. Unfortunately, various authors are inconsistent in this computation. Sometimes authors on livestock basis will compute the basis as the futures price minus the cash price, which changes the sign (+ or -) on the basis. The computation of the cash price minus the futures price is more consistent with usage in the grain trade, where the basis is the amount by which the cash price is above or below the futures price.

and futures prices react to continually developing supply and demand factors, and the future inevitably becomes the present. Thus, the two prices move generally in the same direction, and tend to converge at contract maturity.

Why do they (futures and cash prices) tend to converge? Because at the time of maturity of the futures contract they are interchangeable at designated delivery locations. The following example can be used to explain the concept.

Suppose that in late May the futures price for the June live cattle contract is trading at \$70.00 per cwt. Suppose further that the Omaha cash price (a delivery location) for slaughter steers which meet specifications of the futures contract is \$65 per cwt. If there was a reason to expect the difference in the cash and futures prices to still exist when actual delivery becomes possible beginning June 1, speculators would sell June contracts in the futures market for \$70. When delivery became possible on the first day of June they would go in the yards, buy cattle for \$65, deliver them on the futures, and pocket \$5 per cwt. -- less, of course, the commission and delivery charges. The same type example would apply to slaughter hogs.

However, such profit opportunities normally do not happen. Selling pressure first would develop in the futures market and buying pressure in the cash market, thus forcing the two prices to a difference which approximates the delivery or transportation cost between the two markets. These forces are not as evident during the non-maturity (that is, non-delivery months). It should be apparent that if futures prices are below cash prices by an amount exceeding the delivery cost, speculative action will again bring them reasonably close together.

The convergence of cash and futures prices, sometimes called the narrowing of (or strengthening) the basis, is an important criteria for using the futures market as a risk management tool. The basis most reliably narrows during the time period that livestock can actually be exchanged for a futures contract, called the arbitrage period. It is the threat of delivery during this period that keeps the cash market and the futures market highly correlated. Arbitrage can only occur in the last three weeks prior to the maturity of a futures contract.

For most producers, however, the ability to take advantage of arbitrage is not feasible. Slaughter cattle or hogs cannot be delivered unless they are ready for slaughter in a futures contract delivery period. Slaughter livestock have basically ten days to two weeks when they can be merchandised at the proper weights and grades. In addition, it is difficult to transport either slaughter livestock or feeder cattle over large distances without severe problems in shrink and condition of the animal at the end of the trip.

It may be said with some degree of confidence, however, that the threat of delivery during the arbitrage period is sufficient to keep the two markets closely linked, at least during the period when delivery may in fact take place. More important to the individual producer is the fact that without a fairly clear knowledge of what localized basis adjustments to make for hedged livestock, the risk transference mechanism of the cattle futures is limited.

Detailed examples will not be given for hedging feeder cattle. The same general principles apply as described for slaughter steers or hogs. A backgrounder who has cattle in the lot or on pasture could hedge against a possible drop in price by selling feeder cattle futures which mature about the same time the

feeders will be ready for sale. The backrunner could then either deliver or make an offsetting purchase of the futures contract when the cash feeder cattle are sold.

A cattle feeder could hedge against a possible rise in the price of replacement feeders by buying feeder cattle futures contracts which mature at about the same time the feeder will go into the cash market and buy replacements. Then the feeder can either accept delivery at a delivery point chosen by the futures contract seller or buy the replacements and close out the hedge by making an offsetting sale of the futures contract.

It is possible for a cow/calf operator to hedge the price of his calves by selling a feeder cattle futures contract. This will work to the extent that calf price movements parallel the price movements of feeder cattle. The economic forces which tend to bring the cash futures price of slaughter steers reasonably close together also will bring cash and futures prices of feeder cattle together. But these forces cannot be expected to operate to the same degree with calves because calves are not deliverable on feeder cattle contracts. Thus, hedging strategies for calves would have to include an extra "basis adjustment" for difference in prices for different weights of calves. Feeder pigs could be hedged but the producer must be aware of and able to calculate the proper basis adjustment against the slaughter hog futures contract.

Similarly, heifers can be hedged, if heifer prices move in close concert to steer prices. Again, a basis adjustment would be in order. Hedging heifers or calves or any other class or grade different from that specified in the futures contract would introduce another source of basis risk.

As mentioned earlier, speculative activity is necessary to give the market flexibility and liquidity to absorb hedges without undue price

reaction. It is to the advantage of a short hedger to make the sale at the highest possible price. If the placing of a short hedge (the selling of a futures contract) exerts enough pressure on the market to force the price down when the sale is made, that would work to the disadvantage of the hedger. Conversely, undue buying pressure would cause prices to rise at the disadvantage of the long hedger.

### Calculating the Basis

When the livestock producer or feeder makes the initial decision to hedge, it is not precisely known what the basis will be when the hedge is lifted. That is why the hedger needs to estimate the basis, which is easier than predicting absolute cash prices many months into the future. The easiest way to estimate basis is to examine the pattern of the basis in the past.

The critical point to be made by this Fact Sheet is that an individual livestock producer or feeder who hedges must maintain basis data for each local or nearby market. The livestock producer must decide what futures and cash price data to collect, how many years of data, how to handle the data and how to update the data. The producer or feeder must engage the services of a broker and a lender to assist with hedging decisions and act as part of the hedging team. A computer with appropriate software programs might be considered to assist with data storage and analysis.

It is difficult to cover all the data needs questions and specifics of obtaining basis data. To assist with understanding about the use of basis data the following hedging examples are offered.

### Basis Use In Hedging Examples

Hedging in the futures market is using the futures in such a way as to offset adverse price movements in the cash market. The futures market provides a mechanism for hedging

against either a price decline or a price rise. Positions in the cash market can be hedged by taking a position in the futures market opposite from that in the cash market. Some cattle examples follow but the concept is the same for hogs.

The cattle feeder with cattle on feed takes a position in the cash market when cattle are purchased. In trader language, when a person buys they are said to be "long" the market. The cattle feeder bought feeder cattle, and is long cash cattle. If fearful of a price decline while those cattle are on feed, the cattle feeder can hedge in the futures market by taking an opposite position in the futures. This is done by selling a cattle futures contract. The cattle feeder adjusts the futures price with the best estimate of what the basis will be on the marketing date. The feeder is then said to be "short" the futures markets. Feeder cattle have been bought in the cash market (long cash cattle) and at the same time a cattle contract in the futures is sold (short cattle futures).

In the act of hedging, the cattle feeder transferred the risk of a price decline to the person who took the opposite side of the futures transaction. Someone must take the opposite side—that is, someone must buy the futures contract from the cattle feeder because it takes two parties to make a trade. The "someone" who takes the opposite side of a hedging trade quite often is a speculator. Speculators take a calculated risk in anticipation of a profit. They are necessary in order to provide the liquidity or volume needed to offset the trades being made by actual producers. In many cases, however, it is not a speculator who purchases the offsetting contract, but someone such as a packer who is interested in purchasing futures contracts to protect anticipated slaughter needs against an adverse price move.

At the end of the feeding period the cattle feeder will sell feedlot cattle on the cash market normally used and at the same time buy (remember that a contract was sold originally) a cattle futures contract. The difference (basis) between the cash sell price and the futures price on sale day will be the actual basis. The expected selling price and the final selling price will differ by the amount of error in the original basis estimate. Positions are then closed out in both the cash and the futures markets, although no physical delivery was made on the original futures contract that was sold. How can such a hedge protect the cattle feeder from a risk of a price decline in the cash market? The following example is greatly simplified to illustrate the principle of hedging, with no basis fluctuation.

In every hedge there are four steps to be taken, two in the cash market and two in the futures market. The steps are: (1) Take a position in the cash market, (2) take an opposite position in a futures market (futures price + basis = expected selling price), (3) liquidate the position in the cash market, and (4) liquidate the position in the futures market.

Step number 2 usually is taken at the same time as step number 1. Then, step number 4 usually is taken at about the same time as step number 3. These are generalizations, and under some hedging plans there are exceptions to these rules.

In the following example of hedging feedlot cattle it is assumed that steps number 1 and number 2 are executed at the beginning of the feeding period and steps number 3 and number 4 are executed when the cattle are finished and sold for slaughter.

Assume that 40 head of 650 pound Choice feeder steers are purchased for \$65 per cwt. on March 1, fed 140 days with a gain of 350 pounds per head, and sold July 18 as 1,000

pound Choice slaughter steers. In order to simplify the illustration we assume the following conditions:

- 1) at the time the feeder cattle are bought and put into the feedlot (March 1) a hedge position is taken in the futures market by selling one contract (40,000 pound live weight) of August live cattle futures, which is the contract that expires closest to the time the fed cattle are expected to be sold,
- 2) the hedge position is held until the cattle are sold on July 18, then is closed out by an offsetting purchase in the August futures,
- 3) total feeding costs come to \$7,500,
- 4) the cash market cattle price is \$64 per cwt. on March 1, but drops to \$56 by July 18,
- 5) the August live cattle futures price is \$66 on March 1, and drops to \$57 by July 18, and
- 6) the anticipated basis is -\$1.00 (futures price \$1.00 above cash price). The outcome can be conveniently shown in table form by looking at Table 1.

The net result of the hedged feeding operation, under the conditions set up in this example, is a profit of \$1,600. If the cattle had been fed unhedged the result would have been a loss of \$2,000.

In the example it was assumed that cash cattle prices declined from \$64 per cwt. to \$56 per cwt. during the time the cattle were on feed and the basis was as estimated. It was shown that the hedge provided the protection it was supposed to provide. Hedging is designed to enable one to lock in a margin (hopefully a profit) as protection against an adverse price move, not to necessarily insure higher profits.

In the first example it was assumed that the basis at the time the cattle were sold and the hedge was lifted was -\$1.00. That is, it was assumed the futures price was above the cash price by \$1.00. What would have happened to the bottom line if the actual basis had not been equal to the anticipated basis?

Table 1. Hedging Example When Prices Decline and Basis is Stable.

CASH MARKET		FUTURES MARKET		BASIS
March 1:		March 1:		Estimate
(1) Buy 40 feeder steers, 26,000 lb. @ \$65 per cwt.		(2) Sell 1 Aug. live cattle 40,000 lb. @ \$66 per cwt.		Basis in mid-July of -\$1.00
Cost of Feeders	\$ 16,900	Total value of sale	\$26,400	
Cost of gain	7,500			
Total Cost	\$ 24,400			
July 18:		July 18:		July 18th
(3) Sell 40 Choice fed steers, 40,000 lb. @ \$56 per cwt.		(4) Buy 1 Aug. live cattle 40,000 lb. @ \$57 per cwt.		Sale Day Basis is -\$1.00
..... Total Returns	<u>\$22,400</u>	Total value of purchase	<u>\$22,800</u>	
Returns, cash market (loss)	(\$2,000)	Returns, futures market	\$3,600	
<b>NET RESULTS</b>				
	Gain in futures market	\$ 3,600		
	Loss in cash markets	(\$2,000)		
	Net profit	\$ 1,600		

In Table 2 the same initial assumptions are used but the hedging example is a rising price situation where the basis widens. The futures price is \$3.00 above the cash price (i.e., the basis is -\$3.00) when the cattle are sold and the futures contract is bought back.

The effectiveness of the hedge was lowered significantly by miscalculating the basis. The net profit declined from \$1,600 when the basis was - \$1.00 to \$800 when the basis was -\$3.00. On the other hand, a smaller basis at the time the contract was closed out would have resulted in a larger profit than expected.

### Conclusions

Several factors affect the basis, the difference between the futures market price and the local cash price. These may include distance to delivery point, local supply and demand conditions, plus factors mentioned earlier.

One of the basic tenets for hedging is that variation in the basis will be less than the variation in either the absolute levels of the cash or the futures price. If this were not true,

then hedging could routinely increase price risks for livestock producers rather than decrease price risk.

Producers planning to use the futures market must develop and maintain basis records for the various contract months for slaughter cattle and hogs and feeder cattle. These patterns will serve as a guide for the expected basis in future trading years.

Recently, live cattle futures have gone to the use of a certificate of delivery system to reduce the number of physical deliveries. Discussion is now taking place on the concept of cash settlement for feeder cattle futures. However, for effective hedging, knowledge and understanding of the basis is paramount, even if physical delivery is not used to settle the futures contract.

Table 2. Hedging Example When Prices Decline and Basis Widens.

<u>CASH MARKET</u>		<u>FUTURES MARKET</u>		<u>BASIS</u>
March 1:		March 1:		Estimate
(1) Buy 40 feeder steers, 26,000 lb. @ \$65 per cwt.		(2) Sell 1 Aug. live cattle 40,000 lb. @ \$66 per cwt.		Basis in mid-July of -\$ 1.00
Cost of Feeders	\$ 16,900	Total value of sale	\$26,400	
Cost of gain	7, 500			
Total Cost	\$ 24,400			
July 18:		July 18:		July 18th
(3) Sell 40 Choice fed steers, 40,000 lb. @ \$70 per cwt.		(4) Buy 1 Aug. live cattle 40,000 lb. @ \$73 per cwt.		Sale Day Basis is -\$3.00
Total Returns	<u>\$28,000</u>	Total value of purchase	<u>\$29,200</u>	
Returns, cash market	\$ 3,600	Returns, futures market ( loss)	\$ 2,800	
<u>NET RESULTS</u>				
	Loss in futures market		(\$2,800)	
	Gain in cash markets		\$ 3,600	
	Net profit		\$ 800	

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