HEDGING FEEDER CATTLE IN THE TEXAS PANHANDLE

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ABSTRACT

Feeder cattle producers have traditionally hedged their cattle on a one-to-one basis, that is one pound of futures is used to hedge one pound of expected production. This paper deals with the situation where the producer needs to hedge off-weight steers and heifers. Because the feeder cattle futures prices reflect the prices of 600-800 pound feeder steers, the prices of the feeder cattle futures contract do not change in the same dollar amounts as do the prices of the off-weight steers and heifers. In this situation, a cross hedge should be used. In order to reduce hedging risk when cross hedging, a hedge ratio must be estimated. Tables showing hedge ratios and hedging risk for various weights of Texas Panhandle steers and heifers are presented in the paper.

KEY WORDS: Feeder cattle, hedging, futures, basis, hedging risk

INTRODUCTION

The feeder cattle industry in the Texas Panhandle is affected by many diverse factors including weather, feed prices, government policies, and world market conditions. These dynamic conditions often lead to wide fluctuations in the market price for cattle, especially in the case of feeder cattle. Because feeder cattle prices are so sensitive to these factors, there is a considerable amount of price risk involved in the production and marketing of feeder cattle.

However, cattle producers have a valuable tool which can allow them to shift price risk to speculators. The feeder cattle futures contract, traded on the Chicago Mercantile Exchange (CME) since 1971, can be used to hedge (lock in an approximate price) the purchase or sale of feeder cattle.

Traditionally, feeder cattle have been hedged on a one-to-one basis (i.e. one pound of futures for one pound of expected production). This type of hedging is best suited for feeder steers in the 600-800 pound weight range, which is the weight range specified in the feeder cattle futures contract. But, cattle producers often need to hedge off-weight steers and heifers (that is, any feeder animal other than a 600-800 pound steer). This is difficult because the cash prices of these off-weight cattle move differently from futures prices. Although the feeder cattle contract can no longer be settled by delivery, the cash settlement price is based on the price of 600-800 pound steers. The difference in the movement of the cash price for off-weight steers and heifers relative to the futures price brings about the need to estimate hedge ratios as a means of equating changes in the value of the cash and futures positions. If the feeder cattle to be hedged are not 600-800 pound steers, regression analysis can be used to estimate the relationship between the price of the cattle of a particular weight range and sex and the futures price. The estimated slope coefficient from the regression is commonly called the hedge ratio, and represents the pounds of futures required to hedge one pound of cash feeder cattle.

Although hedging is commonly believed to be a means of reducing price risk (or uncertainty), hedging does not literally lock in an exact price. In actual practice, there is a certain amount of risk involved in hedging. This risk comes from the fact that the net price received from a hedge (cash price received from the cattle plus return from the futures market) is seldom exactly the same as the target price (the price anticipated at the time the hedge was placed). A statistical measure of hedging risk is the standard deviation of the net price about the target price. The standard deviation is in dollars per hundredweight which provides a common sense interpretation of the risk measure.

The second section of the paper briefly reviews articles which deal with hedge ratios and hedging risk for agricultural commodities. An example is given in the third section of a traditional hedge (on a pound-for-pound basis) for 600-800 pound steers. This example is useful in introducing the reader to hedging, and illustrates how 600-800 pound steers are typically hedged. Estimates of basis risk for 600-800 pound steers are reported in the fourth section. The fifth section provides a detailed discussion of hedge ratios and examples of their use. Estimates of hedge ratios are presented for steers and heifers using cash prices from the Amarillo Livestock Auction. A discussion of hedging risk and actual estimates of hedging risk for Texas Panhandle feeder cattle is included. Conclusions are given in the last section of the paper.

PREVIOUS HEDGING STUDIES

The feeder cattle futures contract was first traded as a delivery futures contract. The most noticeable problem with a delivery contract was a volatile basis, even for par grade animals located at delivery points. The volatility of the basis was a major factor in the lack of commercial interest in delivery contracts because of the amount of hedging risk associated with a volatile basis. Cash settlement was introduced with the September 1986 contract as a means to reduce the amount of variation in the basis (Kilcollin, 1985; CME, 1985; and Cattle-Fax, 1985).[1] Basis variation was expected to decrease due to the elimination of problems associated with the delivery of animals, and because cash settlement was supposed to force the futures price to equal the final cash settlement price (Paul, 1987; CME, 1985; and Cattle-Fax, 1985).

Before the change to cash settlement, research indicated that a more stable basis would be achieved with the adoption of cash settlement futures. Studies by Elam and Thompson (1987) and by Elam (1988) found that hedging risk could be reduced for Arkansas feeder cattle. Schroeder and Mintert (1988) concluded that hedging risk could be reduced at four locations in the U.S. by switching to cash settlement. According to Paul (1987), the behavior of feeder cattle prices since the adoption of cash settlement (with the September 1986 contract) supports the proposition that the basis has become less volatile. The only results that do not show basis risk decreasing with cash settlement are for Virginia steers (Kenyon, 1988).

The problem that feeder cattle producers face in hedging is that they often need to hedge off-weight steers and heifers, and no futures contract exists for these animals. Typically, off-weight steers and heifers are hedged on a one-to-one basis (i.e. one pound of futures to hedge one pound of expected production). This is referred to in this paper as a traditional hedge. Many of the basis tables for use in hedging feeder cattle are constructed with the traditional hedger in mind. The basis tables are for cattle in the 600-800 pound range (e.g, Texas A&M University (Davis, et.al., 1989), and Oklahoma State University (Ikerd, undated)). But when the cattle producer needs to hedge off-weight cattle, these basis tables are not really what he needs because the use of the hedge ratio changes the basis relationship.

Anderson and Danthine (1981) theorized that when dealing in a good for which no futures contract exists, a cross hedge may be appropriate. A cross hedge is the use of the futures market to fix a price for a commodity for which no futures contract exists. Anderson and Danthine developed the idea of the hedge ratio, which is important in cross hedging because the units of the cash commodity may not be the same as the units of the futures. Cross hedging calls for the use of a hedge ratio to reduce hedging risk.

Several applications of cross hedging have been reported (e.g., feeder pigs cross hedged with hog and corn futures (Hieronymus (1977, pp. 216-17), and Miller (1982)); wheat mids cross hedged with corn, oats, wheat, and soybean meal futures (Miller (1985)); rice bran cross hedged with corn futures (Elam, Miller, Holder (1986)); wholesale beef prices cross hedged with live cattle futures (Hayenga and DiPietre (1982), and Miller and Luke (1982))). To effectively cross hedge off-weight feeder cattle, a hedge ratio must be estimated to allow for differences in movement of cash and futures prices. Hedge ratios have been estimated for feeder cattle in various weight ranges (Elam, 1988; and Schroeder and Mintert, 1988).

EXAMPLE OF A TRADITIONAL HEDGE FOR 600-800 POUND FEEDER STEERS

Hedging is a process by which the feeder cattle producer can transfer price risk to a speculator in the futures market. However, the hedger assumes basis risk in the process. The basis is equal to the difference

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between the cash price and the futures price (basis= cash-futures). If it is assumed that the basis is constant, the net price from hedging a commodity will equal the price the hedger expected to receive at the time the hedge was initiated. However, the basis is not constant. The actual basis (at the time the hedge is lifted) can be larger than the expected basis (predicted for the time when the hedge is lifted), or it can be smaller than the expected basis. Because of the possibility that the actual basis can be different from the expected basis, there is risk involved in hedging. The greater the variation of the expected basis about the actual basis, the greater the risk. This definition of hedging risk has been used in practical applications (Hieronymus, 1977, p. 208); and Chicago Board of Trade, 1978), and academic studies of hedging (Miller, 1985; Elam, Miller and Holder, 1986; and Elam, 1988).

An example is shown in Table 1 for a cross hedge for 600-800 pound steers to be sold in October. It is assumed that the hedge is placed in April. Because the producer anticipates selling the cattle in October, the hedge should be placed in the October feeder cattle futures contract. The October contract is sold at $78.70 with an expected basis of -$2.00. (Note that all prices throughout the paper are in dollars per hundredweight.) The producer's target price is $76.70 at the time the hedge is placed in April. The target price is calculated by adding the expected basis to the price at which the futures contract is sold ($78.70+(-$2.00)).

Table 1. Example of Hedging 600-800 Pound Feeder Steers.

Date	Cash	Feeder Cattle Futures	Basis
April	Target Price = $76.70	Sell 1 lb. October Feeder Cattle Futures at $78.70	Expected - $2.00
October	Cash Sale Price = $71.25	Buy 1 lb. October Feeder Cattle Futures at $73.50	Actual - $2.25
		Gain + $5.20	$0.25 Decline

Cash Sale Price ($71.25) + Futures Gain ($5.20) = Net Price ($76.45)

Between April and October, feeder cattle prices in the cash market decline. In October, the cattle are sold at the producer's local cash market at $71.25, and the October feeder cattle futures contract is offset at $73.50 for a gain of $5.20 ($78.70-$73.50). The producer's actual basis is -$2.25 which is $0.25 less than was expected. The net price the producer received for the hedged cattle is $76.45. The net price is the sum of the price received from the sale of the cattle in the cash market plus the gain (or minus the loss) in the futures market ($71.25+$5.20).

The difference between the target price and the net price is $0.25, which is the amount the actual basis differs from the expected basis. This $0.25 difference between the net price and the target price represents hedging risk. The net price will always differ from the target price by the amount that the actual basis differs from the expected basis. The risk a hedger faces is the chance that he will receive a net price that is different from the target price. Hedging risk for a traditional hedge is mathematically shown in Elam and Davis (1990).

A hedge does not completely erase risk from the producer's considerations. The producer simply changes the area in which he is taking a risk. When the producer owns unhedged feeder cattle, he is speculating on the price level of his cattle in the cash market. In the example shown in Table 1, the producer would have received $71.25 if he had not hedged the cattle, which is $5.20 less than the net price from hedging. When the producer decides to hedge, he accepts hedging risk as a problem to be tolerated (rather than price level risk). In the example in Table 1, hedging risk is represented by the difference between the net and target prices ($0.25). Because price relationships are historically more predictable than price levels, it should be less risky for the producer to predict his local basis, than to speculate on the actual level of prices in the cash market.

ESTIMATED HEDGING RISK FOR 600-800 POUND FEEDER STEERS

In estimating hedging risk for Texas Panhandle feeder cattle, three series of prices were used. Average cash prices of feeder cattle were collected for the Amarillo Livestock Auction for the period January 1977 to December 1988 (Agricultural Marketing Service, USDA, LS-214 forms). The prices from the Amarillo auction were broken down by weight and by sex. The weights were in 100 pound intervals from 300-800 pounds for both steers and heifers, and in a 200 pound interval from 800-1000 pounds for steers. The Amarillo auction prices are representative of feeder cattle prices in the Texas Panhandle.

Cash settlement futures prices were collected from the Wall Street Journal for the day of the Amarillo auction (usually Monday or Tuesday), and the U.S. Feeder Steer Price (USFSP) was obtained from the CME and Cattle-Fax. The USFSP is the weighted average steer price used to cash settle feeder cattle futures (see footnote 1). The USFSP was used as a proxy for cash settlement feeder cattle futures prices that were not available prior to trading of the September 1986 contract. The justification for this is the fact that cash settlement futures prices will approximately equal the USFSP when the contract expires (Elam, 1988; and Schroeder and Mintert, 1988).

Since a feeder cattle futures contract does not exist for February, June, July, and December, a different procedure had to be used to develop a proxy for the cash settlement futures price for these months. An approximate price was derived by taking the average difference between the average USFSP for each of the months for which there was no contract and the average USFSP for the next contract month, and then subtracting this difference from the USFSP for the month for which there was not a contract. For example, the proxy for the cash settlement futures price for February 1981 was derived by subtracting -$2.44 (the average difference between the February and March USFSP's) from the February USFSP to obtain an approximate February price for the March 1981 cash settlement futures contract (that is, February 1981 price for the March 1981 cash settlement feeder cattle futures contract = February USFSP- (-2.44)). Proxies for cash settlement futures prices were used until September 1986 when the cash settlement futures price was available.

Table 2 shows the basis information for 600-700 and 700-800 pound feeder steers from 1977-88. The average basis, the high (most positive) basis, the low (most negative) basis, and the standard deviation of the basis are shown in Table 2. (The variance is the average of the squared deviations from the mean; and the standard deviation is the square root of the variance (Alder and Roessler (1975, p. 48).) The average basis tends to be positive in almost every month for both 600-700 and 700-800 pound steers. The highest average basis is for 600-700 pound March feeder steers, where the average basis is $2.27 (i.e., March cash price is $2.27 over the March futures contract price). The lowest average basis is for 700-800 pound June feeder steers, where the average basis is -$2.90.

The greatest range in the nearby basis for one month is for 600-700 pound June feeder steers, where the basis ranged from -$5.28 to +$5.43. The wide variation in the June basis is partly due to the fact that the nearby futures contract is August, which is two months away.

The greatest amount of hedging risk as measured by the standard deviation of the basis is for 600-700 pound June steers. The standard deviation of the June basis is $2.02. As was shown in the example in the previous section, the difference between the actual and the expected basis

[1]In cash settlement, all contracts remaining open at contract expiration are settled in cash based on the final settlement price, rather than by physical delivery of steers. The final settlement price is a weighted average of actual cash market prices for 600-800 pound steers that are expected to grade 60-80% Choice at slaughter. The final settlement price is known as the U.S. Feeder Steer Price (USFSP), and is calculated by the market information organization Cattle-Fax. The USFSP is derived using auction and direct sales prices from 27 states. The procedure used to calculate the USFSP is explained by the CME (1985).

Table 2. Average Basis, High Basis, Low Basis, and Standard Deviation of the Basis for 600-800 pound Amarillo Steers, 1977-88.

	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
						(dollars per hundredweight)						
600-700 lbs.												
Avg Basis	1.84	-3.33	2.27	1.72	0.91	-1.24	-0.13	1.25	0.93	0.62	0.98	0.65
High Basis	3.38	3.55	5.08	6.18	6.30	5.43	4.68	3.13	3.35	3.44	3.53	3.58
Low Basis	-3.09	-1.92	-1.00	-1.33	-2.46	-5.28	-2.36	-1.60	-1.56	-2.57	-2.35	-1.67
s a/	1.01	1.19	1.41	1.38	1.62	2.02	1.70	0.97	1.07	0.96	1.38	1.09
700-800 lbs.												
Avg Basis	0.73	-1.47	0.90	0.18	-0.94	-2.90	-1.71	-0.17	-0.58	-0.70	-0.41	-0.67
High Basis	3.38	1.53	2.99	2.36	1.88	0.93	0.68	2.13	1.22	2.17	3.13	1.94
Low Basis	-3.09	-5.19	-2.36	-3.39	-4.21	-6.65	-4.90	-5.32	-4.01	-4.07	-4.28	-4.67
s	1.43	1.55	1.35	1.40	1.44	1.60	1.21	1.44	1.40	1.11	1.64	1.52

a/ "s" is the standard deviation of the basis.

is equal to the difference between the net price and the target price. Therefore, the standard deviation of the basis is a measure of hedging risk. Assuming a normal distribution for the basis, the net price received from hedging 600-700 pound June steers will differ from the target price by no more than $2.02 two-thirds of the time, and by no more than $4.04 (two standard deviations) ninety-five percent of the time.

The least amount of hedging risk is for 600-700 pound October steers where the standard deviation of the basis is $0.96. This number is interpreted in the same manner as in the explanation above.

CROSS HEDGING FEEDER CATTLE

Many times cattle producers may wish to hedge lighter or heavier weight steers or heifers. In this case, a cross hedge should be used. The example in Table 1 illustrates a hedge of 600-800 pound steers and assumes a one-to-one relationship between the pounds of expected production and the pounds of feeder cattle futures sold as a hedge. But when a cross hedge is used, a one-to-one relationship may not be the optimum risk minimizing position. This is due to the fact that the prices of feeder cattle of different weight ranges and sex do not move in the same dollar amount. For example, the relationship between the price of 400-500 pound steers at Amarillo during November and the price of November feeder cattle futures (which reflect the price of 600-800 pound steers) is shown in Figure 1. The slope of a regression line fitted to the two series of prices for the years 1977-88 is 1.2. The slope coefficient indicates that each $1 change in the price of feeder cattle futures is associated on average with a $1.20 change in the price of 400-500 pound steers.

If a cattle producer hedges 1 pound of expected production of 400-500 pound steers with 1 pound of feeder cattle futures, he will be partially hedged because of the difference in the variability of 400-500 pound steer prices and futures prices. According to the regression relationship in Figure 1, each $1.20 change in 400-500 pound steer prices is associated with a $1 change in futures prices. If the hedge is pound for pound, the change in the value of the cash position will be 1.2 times as great as the change in the value of the futures position. Ideally when hedging, the value of the futures position should change dollar for dollar with the value of the cash position. When hedging 400-500 pound steers, this requires a larger futures position to make the change in the values of the cash and futures positions equal.

The particular size of the futures position can be determined from a regression of cash on futures prices.

(1) $C_t = a + bF_{t-j} + e_t$

where "a" and "b" are estimated intercept and slope coefficients, respectively, and e_t is the estimated random error term. The estimated slope coefficient from the regression is the hedge ratio, which is the number of pounds of futures needed to hedge one pound of cash feeder cattle.

An example is shown in Table 3 for a cross hedge for 400-500 pound steers to be sold in November at Amarillo. It is assumed that the hedge is placed in April. The hedge ratio for November 400-500 pound steers is 1.2, which indicates that 1.2 pounds of November futures should be sold for each 1 pound of expected production of November steers (hedge ratios are reported in Table 4). The target price for the hedge is $90.17. The target price is calculated by adding the average November generalized basis for 400-500 pound Amarillo steers (Table 5) to the sum of 1.2 multiplied by the April price of the November feeder cattle futures contract (-$3.43+1.2($78.00)). The generalized basis of -$3.43 represents the average difference in value of 100 pounds of 400-500 pound steers at Amarillo during November and 120 pounds of feeder cattle futures at the same time.

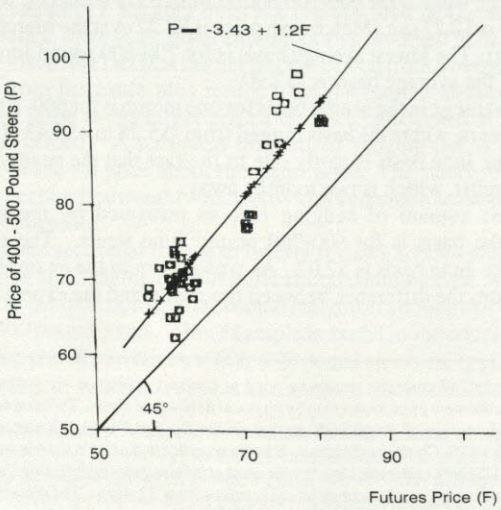

Figure 1. November Cash Price of 400-500 Pound Steers at Amarillo vs. November Feeder Cattle Futures Price, 1977-88.

Table 3. Example of Hedging 400-500 Pound Feeder Steers.

Date	Cash	Futures Cattle Futures	Generalized Basis
April	Target Price = -$3.43 + 1.2($78.00) = $90.17	Sell 1.2 lbs. November Feeder Cattle Futures at $78.00	Expected - $3.43
November	Cash Sale Price = $83.50	Buy 1.2 lbs. November Feeder Cattle Futures at $74.00	Actual - $5.30
		Gain 1.2($4.00) = $4.80	$1.87 Decline

Cash Sale Price ($83.50) + Futures Gain ($4.80) = Net Price ($88.30)

Determining the target price is similar for cross hedging 400-500 pound steers compared to hedging 600-800 pound steers. The difference is that in a traditional hedge the basis (C_t-F_t) is added to the futures price, whereas in a cross hedge the generalized basis (C_t-bF_t) is added to the sum of the hedge ratio (b) multiplied by the futures price.

Because 1.2 pounds of feeder cattle futures are required to hedge 1.0 pound of 400-500 pound steers, the sale of one 44,000 pound feeder cattle futures contract will hedge approximately 81 head of November steers. If the producer anticipates selling 400 head of 400-500 pound steers in November, he would need to sell 216,000 pounds (1.2 x 450 pounds x 400 head) of November futures. This is approximately five feeder cattle futures contracts.

During April, 1.2 pounds of November feeder cattle futures are sold for each pound of expected production of November steers. The April selling price of the November futures contract is $78.00. Between April and November, cash and futures prices decline. The 400-500 pound steers are sold during November for $83.50, and at the same time, the futures position is offset at $74.00. The gain on the futures position is $4.80 per hundredweight of cash feeder cattle (1.2($78.00-$74.00)). The net price the producer receives for the hedged cattle is $88.30. The net price for a cross

Table 4. Hedge ratios for Amarillo Feeder Cattle, 1977-88.

	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
						(pounds)						
Steers:												
300-400 lbs.	1.22	1.37	1.53	1.59	1.70	1.71	1.61	1.45	1.40	1.48	1.31	1.33
400-500 lbs.	1.11	1.24	1.33	1.38	1.39	1.45	1.39	1.21	1.24	1.25	1.20	1.20
500-600 lbs.	1.03	1.13	1.14	1.15	1.19	1.21	1.20	1.08	1.12	1.08	1.05	1.07
600-700 lbs.	0.98	1.03	1.05	1.04	1.04	1.05	1.08	1.04	1.02	1.02	0.98	0.99
700-800 lbs.	0.95	0.96	1.00	0.97	0.97	0.98	1.00	0.98	0.96	0.96	0.94	0.91
800-1000 lbs.	0.74	0.82	0.89	0.89	0.90	0.98	1.08	0.83	0.83	0.86	0.81	0.77
Heifers:												
300-400 lbs.	1.12	1.24	1.36	1.39	1.48	1.54	1.46	1.34	1.36	1.34	1.20	1.22
400-500 lbs.	1.06	1.13	1.18	1.23	1.26	1.26	1.27	1.13	1.16	1.16	1.08	1.11
500-600 lbs.	0.99	1.02	1.03	1.06	1.08	1.10	1.10	1.04	1.05	1.05	1.04	1.05
600-700 lbs.	0.97	0.95	0.96	0.96	1.00	1.04	1.03	0.99	0.97	0.98	0.96	0.97
700-800 lbs.	0.83	0.88	0.91	0.85	0.94	1.34	1.12	0.95	0.96	0.98	0.95	0.95

Note: The hedge ratio (b-value from eq. (1) in text) is the number of pounds of feeder cattle futures required to hedge one pound of cash feeder cattle.

Table 5. Generalized Basis for Amarillo Feeder Cattle, 1977-88.

	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
						(dollars per hundredweight)						
Steers:												
300-400 lbs.	-2.81	-13.30	-18.11	-19.83	-26.16	-28.92	-24.83	-13.01	-11.32	-17.26	-6.00	-10.41
400-500 lbs.	-0.24	-9.81	-11.27	-12.31	-11.68	-19.36	-16.47	-4.53	-7.22	-7.39	-3.43	-6.91
500-600 lbs.	2.01	-6.12	-3.91	-3.64	-6.19	-10.40	-9.29	-1.60	-4.33	-1.53	0.89	-1.81
600-700 lbs.	2.99	-1.77	-0.83	-0.71	-1.67	-4.60	-5.37	-1.04	-0.65	-0.58	2.47	1.34
700-800 lbs.	3.79	1.03	1.12	2.28	0.82	-1.46	-1.44	1.06	2.17	1.87	3.54	5.36
800-1000 lbs.	15.34	8.80	6.37	5.15	3.42	-3.35	-8.79	8.50	8.55	6.47	9.75	12.32
Heifers:												
300-400 lbs.	-8.75	-17.75	-20.89	-20.50	-24.65	-31.52	-27.91	-19.07	-21.28	-20.83	-12.87	-16.11
400-500 lbs.	-7.01	-13.17	-12.66	-14.11	-16.04	-18.94	-19.55	-10.42	-12.35	-13.13	-7.53	-11.22
500-600 lbs.	-3.78	-7.12	-5.15	-6.34	-8.99	-12.36	-11.85	-6.61	-8.21	-8.80	-7.41	-8.64
600-700 lbs.	-2.68	-3.19	-1.62	-1.53	-5.12	-9.44	-8.24	-4.13	-3.65	-4.64	-3.91	-4.08
700-800 lbs.	5.43	0.86	1.11	-4.47	-2.38	-29.66	-14.31	-2.71	-3.96	-5.83	-4.25	-4.09

Note: The generalized basis is G=C-F, which is the a-value from eq. (1) in the text.

hedge is calculated in the same way as it is for a 600-800 pound steer hedge when b=1. That is, the net price is the sum of the cash sales price for the cattle plus the return from the futures market ($83.50+$4.80=$88.30).

The difference between the net and target prices is -$1.87, which is the same as the difference between the actual November generalized basis and the expected generalized basis (-$5.30-(-$3.43)). This difference represents hedging risk, just as the difference between the net price and the target price represents hedging risk when b=1. Although the mechanics of a cross hedge and a hedge are somewhat different, the concept is basically the same for both. A detailed explanation and mathematical representation of cross hedging is provided in Elam and Davis (1990).

Hedging risk for cross hedges is reported in Tables 6 (steers) and 7 (heifers). The standard deviation of the net price about the target price is one measure of hedging risk. Also included in Tables 6 and 7 are ranges for net minus target prices. The range gives the largest negative and positive amounts that the net price has missed the target price for the years 1977-88. As measured by the standard deviation, hedging risk is greatest for 300-400 pound steers sold in May, where the standard deviation of net minus target prices is $5.28. Assuming a normal distribution for net minus target prices, there is approximately a 68% chance that the net price will be within $5.28 per hundredweight (either positive or negative) of the target price. The range in the net price about the target price for May 300-400 pound steer hedges is from -$10.74 to $8.98. This indicates that over the period 1977-88 the net price was as much as $10.74 below the target price and as much as $8.98 above the target price.

Table 6. Hedge Risk for Amarillo Feeder Steers, 1977-88.

Weight (pounds)	300-400	400-500	500-600	600-700	700-800	800-1000
			(dollars per hundredweight)			
Jan						
s a/	4.60	2.43	1.50	1.00	1.30	1.40
Range b/	-8.35 to 12.54	-5.47 to 6.56	-4.51 to 3.78	-4.64 to 1.57	-3.05 to 2.72	-2.61 to 2.42
Feb						
s	5.16	3.59	2.15	1.16	1.49	1.43
Range	-9.84 to 9.77	-8.58 to 7.69	-4.11 to 6.22	-1.91 to 3.23	-3.17 to 3.05	-3.13 to 2.91
March						
s	4.83	3.04	1.64	1.31	1.35	1.60
Range	-7.62 to 9.68	-5.45 to 5.45	-3.23 to 3.26	-3.42 to 2.51	-3.21 to 2.09	-3.84 to 3.27
April						
s	4.71	3.63	2.39	1.31	1.36	1.76
Range	-9.98 to 7.52	-5.17 to 8.63	-2.83 to 6.29	-2.74 to 3.63	-3.03 to 2.80	-3.53 to 3.06
May						
s	5.28	3.48	2.43	1.58	1.42	2.13
Range	-10.74 to 8.98	-8.40 to 5.51	-5.21 to 5.72	-4.07 to 4.59	-3.09 to 3.19	-4.89 to 4.05
June						
s	5.17	4.39	2.89	1.98	1.60	1.62
Range	-7.22 to 12.08	-8.79 to 8.86	-5.15 to 7.82	-4.74 to 6.25	-3.45 to 3.94	-4.15 to 2.52
July						
s	5.17	4.15	2.34	1.52	1.24	1.23
Range	-9.81 to 10.46	-6.19 to 11.18	-3.42 to 6.02	-3.02 to 4.32	-3.17 to 2.38	-4.09 to 1.49
Aug						
s	4.52	3.10	1.77	.91	1.44	1.79
Range	-9.12 to 8.36	-7.40 to 9.79	-3.51 to 6.26	-2.64 to 1.61	-5.01 to 2.31	-5.24 to 2.90
Sept						
s	4.32	3.68	1.95	1.05	1.32	1.89
Range	-9.57 to 7.58	-6.21 to 9.35	-2.82 to 5.26	-2.56 to 2.09	-2.79 to 2.10	-3.29 to 3.04
Oct						
s	4.08	2.41	1.64	.95	1.03	1.61
Range	-10.48 to 9.35	-5.51 to 5.11	-3.57 to 3.78	-3.37 to 2.59	-3.00 to 2.76	-2.57 to 3.93
Nov						
s	4.37	3.47	2.03	1.38	1.53	1.92
Range	-8.39 to 10.26	-7.22 to 7.89	-3.78 to 4.04	-3.06 to 2.55	-3.17 to 3.40	-4.99 to 3.30
Dec						
s	5.27	2.95	1.91	1.09	1.20	1.48
Range	-9.52 to 10.22	-5.16 to 5.22	-3.62 to 4.40	-2.19 to 2.93	-2.35 to 2.31	-4.85 to 2.88

a/ "s" is the standard deviation of the net price from the target price.
b/ Range is the greatest negative and the greatest positive amount that the net price has missed the target price.

Table 7. Hedge Risk for Amarillo Feeder Steers, 1977-88.

Weight (pounds)	300-400	400-500	500-600	600-700	700-800
			(dollars per hundredweight)		
Jan					
s a/	3.10	2.20	1.31	1.23	1.61
Range b/	-4.81 to 7.94	-3.79 to 4.62	-2.57 to 3.11	-3.37 to 3.41	-5.43 to 3.21
Feb					
s	4.65	3.47	2.07	1.83	1.60
Range	-8.52 to 7.28	-5.55 to 6.78	-3.75 to 4.31	-4.33 to 4.97	-3.55 to 3.62
March					
s	4.02	2.66	1.68	1.32	1.51
Range	-7.62 to 9.67	-5.59 to 4.43	-4.35 to 3.65	-3.94 to 2.68	-4.42 to 2.62
April					
s	4.31	3.24	1.64	1.05	1.07
Range	-7.71 to 6.67	-6.08 to 7.12	-3.53 to 3.78	-2.10 to 2.69	-1.81 to 1.80
May					
s	4.40	3.18	1.81	1.11	1.30
Range	-8.06 to 6.79	-6.98 to 6.88	-4.01 to 2.89	-2.07 to 2.12	-2.50 to 2.34
June					
s	6.91	4.06	2.22	2.10	1.64
Range	-11.61 to 13.22	-7.32 to 9.54	-3.48 to 5.47	-2.83 to 5.46	-2.35 to 3.62
July					
s	4.92	3.46	2.17	1.37	1.43
Range	-12.31 to 10.70	-8.12 to 5.81	-3.53 to 5.09	-2.49 to 3.71	-4.01 to 2.82
Aug					
s	3.93	2.80	1.59	1.28	1.80
Range	-7.34 to 10.50	-4.61 to 8.32	-2.58 to 3.03	-3.40 to 3.19	-6.37 to 2.61
Sept					
s	4.44	3.23	1.90	1.40	1.54
Range	-8.14 to 8.30	-5.33 to 4.83	-3.47 to 3.95	-2.80 to 3.03	-3.99 to 2.39
Oct					
s	3.62	2.70	1.75	1.32	1.52
Range	-8.40 to 5.85	-5.46 to 5.38	-4.06 to 3.58	-2.66 to 3.17	-3.21 to 3.58
Nov					
s	4.01	2.83	1.88	1.35	1.51
Range	-7.50 to 6.55	-5.35 to 4.11	-3.84 to 3.39	-2.94 to 2.56	-2.60 to 3.25
Dec					
s	4.25	3.15	2.23	1.49	1.64
Range	-7.67 to 8.05	-5.94 to 7.03	-4.31 to 5.48	-4.13 to 3.15	-4.11 to 2.99

a/ "s" is the standard deviation of the net price from the target price.
b/ Range is the greatest negative and the greatest positive amount that the net price has missed the target price.

The least amount of hedging risk is for 600-700 pound steers sold in August (Table 6). The standard deviation of the net price from the target price is $0.91, which indicated a 68% chance that the actual net price received will be within $0.91 per hundredweight of the target price. Hedging risk tends to be lowest for steers weighing 600-800 pounds. This was expected because the USFSP, which is used to cash settle the feeder cattle futures contract, is based on 600-800 pound steer prices.

CONCLUSIONS

The traditional manner in which feeder cattle are hedged is on a one-to-one basis. As we have seen, this method of hedging is not the optimal risk reducing position when hedging off-weight steers and heifers. In these situations, a cross hedge should be used instead of the traditional hedge.

The results of this study were as expected. Hedge ratios were found to be approximately 1.0 for feeder cattle in the 600-800 pound range. The results also show that hedge ratios tend to be higher for lighter weight cattle and lower for heavier weight cattle.

Hedging risk was found to be lowest for 600-800 pound steers, where the standard deviations of net minus target prices ranged from $0.91 to $1.98. The least amount of hedging risk was for 600-700 pound feeder steers to be sold in August (standard deviation of $0.91). The greatest amount of hedging risk was for 300-400 pound steers and heifers, where the standard

deviations of net minus target prices ranged from $3.10 to $6.91. The standard deviation of $6.91 was for 300-400 pound heifers to be sold in June. Overall, hedging risk tended to be greater for cattle with weights that were outside the 600-800 pound range, which shows the need for using hedge ratios when cross hedging off-weight feeder cattle.

While this study used information from the Amarillo Livestock Auction and applies to the Texas Panhandle, the procedures used are applicable to other markets. There would be differences, however, in the magnitude of the hedge ratios and the actual amount of hedging risk in other markets

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