Spatial Analysis of Feeder Cattle Hedging Risk

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Abstract: Optimal hedge ratios are estimated for various weights of feeder cattle in four cash markets based on CME data from 1992 to 1999. Three-month uniform hedges are simulated for every weight, contract, and cash market combination. Hedging effectiveness is compared empirically across locations to identify spatial differences in hedging risk.

Keywords: feeder cattle, hedging risk, hedge ratios

Introduction

Price risk associated with buying and/or selling feeder cattle can be transferred to speculators using the Chicago Mercantile Exchange (CME) feeder cattle contract (Elam and Davis). CME feeder cattle contracts from January 1992 until November 1999 were specified for 700 to 799 pound medium frame #1 and medium to large frame #1 steers.[1] However, many buyers and sellers deal in feeder cattle that do not conform to these contract specifications. For instance, feeder cattle ranging from 350 to 900 pounds are commonly bought and sold. In the past, the CME feeder cattle contract has been utilized to manage price risk of feeder cattle across this entire weight range. Using a futures contract to hedge a commodity that does not exactly match the contract specifications is technically cross hedging (Leuthold, Junkus, and Cordier).

The process of cross hedging is not as straightforward as a traditional hedge since the differences in the futures commodity and the commodity being cross hedged often result in differing price movements and volatilities. To account for these differences, a ratio hedge can be used. In the case of feeder cattle this involves acquiring a futures market position of either more or less pounds than the amount actually being hedged depending on the volatility of the commodity being hedged relative to the commodity specified by the futures contract. The hedge ratio will determine a hedger's ability to predict the actual net cash price realized. A hedger's ability to predict net cash price determines the amount of hedging risk associated with a hedge or cross hedge. It is of great importance that producers executing cross hedges choose a hedge ratio that introduces as little hedging risk as possible and therefore effectively manages feeder cattle price risk.

[1] Beginning with the January 2000 contract 700 to 849 pound medium frame #1 and medium large frame #1 steers are specified.

Numerous studies have estimated hedge ratios for both steers and heifers of various weight categories. These studies also analyzed the hedging risk associated with using these ratios to execute cross hedges with the CME feeder cattle contract (Elam, Elam and Davis, Schroeder and Mintert). It has been established across these studies that different hedge ratios are appropriate for different sexes and weight categories and that the CME feeder cattle contract is indeed an effective risk management tool in cross hedging scenarios. However, these studies have, in general, been location specific and have not brought to light any spatial effects on hedge ratios or on the hedging risk resulting from utilizing these ratios. Simple observation makes it obvious that feeder cattle prices from different regions of the United States typically differ in both level and volatility. It is reasonable to expect that these differences could affect a producer's ability to cross hedge (or hedge as the case may be) the sale or purchase of feeder cattle from on region of the country to another. Specifically, two major differences could be expected. First, different hedge ratios for a given weight category of feeder cattle will likely be appropriate for different locations. Second, and perhaps more importantly, producers in different locations might face different levels of hedging risk and therefore different degrees of hedging effectiveness. If these differences do indeed exist identifying and quantifying them could enhance producers' abilities to effectively manage the price risk of their respective operations.

The general objective of this study is to determine what, if any, spatial differences are present in the management of feeder cattle price risk using the CME feeder cattle contract. Specifically, average bases and hedge ratios for 4 feeder cattle markets representing the Southwest, Northwest, West, and Midwest will be estimated across a range of weight categories for every CME feeder cattle contract. These hedge ratios and bases will be used to simulate hedges from 1993 to 1999. The results of these hedges will then be used to determine the hedging risk present for each weight category at each location using each available futures contract. Finally, the effects of location, contract month, and weight on hedging risk will be estimated using linear regression analysis. Furthermore, the effects of interactions between location and the other aforementioned factors on hedging risk will be evaluated. Results of this estimation will be of interest not only to buyers and sellers of feeder cattle but also to those interested in the effectiveness of the CME feeder cattle contract as both a risk management and price discovery mechanism.

Background

Numerous cross hedging studies have been conducted on a wide variety of commodity/futures contract combinations. While these studies vary in the commodities analyzed, they all focus on the ability (or lack thereof) to manage the price risk of a good for which no exact futures contract is available. The theoretical foundation for cross hedging was established by Anderson and Danthine. They state that when no obvious futures contract exists for a good, a cross hedge may be placed by taking a position in a related futures market contract. Anderson and Danthine note that a correlation coefficient between the cash price of the good and the futures contract price that is statistically different from zero is an indication that a cross hedge may be appropriate. Once an appropriate contract has been identified, the volatility of the cash price relative to futures price must be considered. This relative movement in prices determines the hedge ratio or how much of a cash position can be hedged using a futures contract. The estimation of these ratios has been an area of considerable disagreement between cross hedging studies.

Witt, Shcroeder, and Hayenga summarized three common approaches to the estimation of optimal hedge ratios: (1) price level models, (2) price change models, and (3) percentage change price models. They argue that the objectives of the hedger, the nature of the relationship between cash and futures prices, and the type of hedge being placed (storage or anticipatory) ultimately determine which estimation procedure is appropriate. They conclude that for anticipatory hedges, the price level model is appropriate except in cases where: (1) the cash and futures market price relationship is nonlinear in the levels, (2) the price level equations exhibit strong positive autocorrelation, or (3) first order autocorrelation occurs.

The price level model involves using linear regression analysis to determine the relationship between cash and futures market prices. This approach to optimal hedge ratio estimation has also been widely used to estimate hedge ratios for cross hedging many types of cattle. Schroeder and Mintert use the approach to determine the effectiveness of hedging feeder heifers and steers that do not exactly meet the specifications of available cash-settled feeder cattle futures contracts. Elam and Davis use a price level model to compare the hedging risk of traditional hedges versus ratio hedges, which is a hedge in which the commodity can not be hedged on a one to one basis with existing futures market contracts. Buhr employs a very similar methodology to evaluate the hedging of finished Holstein steers using live cattle futures contracts. Buhr suggests that for nonstorable commodities, such as live cattle, the hedge is anticipatory. In the case of an anticipatory hedge, the current cash price is unattainable and therefore of little interest to a hedger (Witt, Shcroeder, and Hayenga). Buhr goes on to state that a producer hedging in this situation is primarily concerned with ending basis risk. Feeder cattle of any classification are nonstorable commodities. Thus, a hedger buying or selling feeder cattle would be primarily concerned with the basis relative to the nearby futures contract at the time the hedge is to be lifted, making the hedging of feeder cattle anticipatory. This suggests that the price level model is an appropriate method to estimate optimal hedge ratios in this study.

All of the aforementioned studies have used the estimated optimal hedge ratios to simulate ratio hedges and analyze the results to quantify the hedging risk associated with cross hedging. According to Elam, the standard error of the net cash price received about the expected net cash price can be interpreted as hedging risk. This is also the method is used by Buhr; Elam and Davis; and Schroeder and Mintert. The resulting standard error can be expressed in units that are appropriate to the situation and commodity (Blake and Catlett). For example, in the case of feeder cattle, the measure of hedging risk would be in dollars per cwt. Reporting hedging risk in this manner makes interpretation very straightforward and intuitive.

This well-pronounced presence of livestock cross hedging studies in the agricultural economic literature has established the potential for managing feeder cattle price risk via cross hedging. Furthermore, the hedging risk present in these cross hedges has been quantified for many specific cases. These include: hedging cattle that differ from the contract by both sex and weight with cash settled and delivery futures contracts in various cash markets (Shcroeder and Mintert), hedging offweight cattle in the Amarillo, Texas market (Elam and Davis), and hedging offweight cattle in the Arkansas cash market (Elam). Collectively, these studies and their respective results indicate that cross hedging feeder cattle can indeed be an effective risk management strategy but that depending upon how cattle conform to the CME feeder contract and the cash market in question, hedgers may face different levels of hedging risk.

The presence of these differences in hedging risk makes it worthwhile to go beyond a location specific framework and attempt to identify the factors that ultimately determine the hedging risk that a producer might face. By replicating the hedge ratio estimation and hedge simulation process for multiple weights and locations to arrive at the hedging risk present in each case, the information necessary to identify these factors can be generated. The data and methodology necessary to accomplish this are presented in the following section.

Data and Methods

Cash prices for medium frame #1 feeder steers ranging from 600 to 850 pounds (classified in 50-pound increments) were obtained from the USDA *Livestock, Meat, and Wool Weekly Summary and Statistics* for four feeder cattle markets from January 1993 to December 1999. These markets were chosen to represent different regions of the United States in the interest of highlighting general effects of each location on feeder cattle hedging risk. The markets chosen were Amarillo, Texas; Dodge City, Kansas; Colorado; Washington to represent the Southwest, Midwest, West and Northeast respectively. Weekly average settle prices on the CME feeder cattle futures contract were collected for the same time period. A price series for each futures contract was collected and a nearby futures price series was constructed for the entire time period. The nearby contract was defined as the nearest available contract up to the last day of the month prior to contract expiration. For example in January 1993 the nearby contract would be the March 1993 contract and this would remain so until February 29, 1993 at which point the April 1993 contract would become the nearby contract. Descriptive statistics for all cash series and the nearby futures series are reported in Table 1. Using this nearby series, the relationship between each cash price series and futures prices can be identified.

The relationship between a feeder cattle cash price series and a futures contract is best estimated using the nearby futures price since cash prices tend to be more correlated with the nearby futures contract price than with any other futures contract. Because of this correlation, hedgers generally use the nearby contract since hedging risk is lower. (Elam and Davis).

Specifically, this relationship will allow for the estimation of an optimal hedge ratio and, for the purposes of this study is specified as follows:

(1) $C_{t,m,w} = \beta_o + \beta_1 F_t + \varepsilon_t.$

In this formulation $C_{t,m,w}$ represents the cash market price in time period t (in weeks), at market location m for feeder cattle of weight w, while F_t is the nearby futures price, as defined earlier in this section, in time t. β_o is the intercept term and represents the average basis at the time hedges are lifted. β_1 represents the hedge ratio and can be interpreted as the expected change in a cash price series given a change in the nearby futures price. ε_t is an error term in time t.

By estimating equation 1 for every combination of contract month (c), m, and w hedge ratios can be obtained for each combination. This estimated hedge ratio (b_1) represents how volatile a cash price series is relative to futures prices. For cash price series that exhibit change in response to market signals greater than those of futures prices b_1 will be greater than 1. b_1 can also be used to determine how many pounds of live feeder cattle can be hedged using a feeder cattle futures contract. That relationship is defined as:

(3) $Q_c = Q_f / b_1,$

where Q_c represents the pounds of live feeder cattle in the cash market that can be hedged assuming that Q_f pounds is specified by the CME feeder cattle contract.

The estimated parameters of equation 1 can also be used to determine the expected or target price (EP) of a hedge and the net cash price realized (NCP) for the same hedge as follows:

(4) $EP = b_o + b_1 F_{t=s}$

(5) $NCP = C_{t=l} + b_1 (F_{t=s} - F_{t=l}).$

b_o and b_1 are the estimates from equation 1 of $\beta_o + \beta_1$,respectively. At the time the hedge is set t = s and in the week the hedge is lifted, t = l. Comparing the NCP with the predicted EP allows the effectiveness of a hedge to be judged.

The effectiveness of a hedge depends directly upon the ability to predict NCP. This is because the objective of a hedger is not to enhance income but rather to “lock-in” an EP subject to hedging risk. So as NCP becomes more different (either positively or negatively) than EP a hedge is considered to be less effective. For a perfect hedge EP = NCP. In the real world perfect hedges rarely occur and then only by chance. A hedger operates with the understanding that he/she cannot literally lock-in an NCP and therefore will face some hedging risk. This hedging risk can be defined as the standard deviation of NCP-EP (Elam). Buhr; Elam and Davis; and; Schroeder and Mintert have also used this definition of hedging risk in livestock cross hedging studies. This measure of hedging risk is defined in this paper and all aforementioned studies as:

(6) $$\text{StDev(NCP-EP)} = \_\__e\left\{1 + 1/n + [(F_{t=s} - F_m)^2 + \_\__v^2] / [\_\_(F_{t=l} - F_m)^2]\right\}^{½} .$$

In this formulation $\_\__e$ is the root-mean square error from the estimation of equation (1). n is the number of observations present in the estimation of equation 1, F_m is the mean of all $F_{t=l}$, and $\_\__v^2$ is the standard error of the change in futures prices over the duration of the hedge. All other variables maintain their previous definitions. This equation reveals the ability of the cross hedge to predict the NCP over time. Specifically, a hedger’s NCP should be within one standard deviation of (EP - NCP) of EP about two-thirds of the time (Elam and Donnell). This measure of hedging risk can be calculated for every w, m, and (c) across all years (1993-1999). In all equation specifications, the StDev(NCP-EP) will be referred to as $\sigma_{m, w, c}$ to clearly note that it is measured under several different combinations of m, w, and c.

As mentioned earlier, previous studies have measured this hedging risk for specific locations and in some cases, a selection of locations. The purpose of this study is to carry this analysis further and examine not only the difference in magnitude of hedging risk under these scenarios but to also quantify the effects of various factors on hedging risk. This will allow hedgers to better understand the sources of risk that they actually face. By simulating hedges based on the aforementioned data via equations 4 and 5, a $\sigma_{m, w, c}$ can be estimated for every m, w, and c combination. By regressing relevant independent variables on $\sigma_{m, w, c}$ the effects of certain factors on hedging risk can be quantified. Specifically, this study proposes the following model:

(7) $$\sigma_{m, w, c} = \beta_1 KMAR + \beta_2 KAPR + \beta_3 KMAY + \beta_4 KAUG + \beta_5 KSEP + \beta_6 KOCT + \beta_7 KNOV + \beta_8 TMAR + \beta_9 TAPR + \beta_{10} TMAY + \beta_{12} TAUG + \beta_{13} TSEP + \beta_{14} TOCT + \beta_{15} TNOV + \beta_{16} CMAR + \beta_{17} CAPR + \beta_{18} CMAY + \beta_{19} CAUG + \beta_{20} CSEP + \beta_{21} COCT + \beta_{22} CNOV + \beta_{23} WMAR + \beta_{24} WAPR + \beta_{25} WMAY + \beta_{26} WAUG + \beta_{27} WSEP + \beta_{28} WOCT + \beta_{29} WNOV + \beta_{30} KHI25 + \beta_{31} THI25 + \beta_{32} CHI25 + \beta_{33} WHI25 + \beta_{34} KLO25 + \beta_{35} TLO25 + \beta_{36} CLO25 + \beta_{37} WLO25.$$

In this regression the intercept term is omitted. This is because an intercept in this case would represent some average hedging risk for all m, w, and c and would therefore be of little intuitive value for the purposes of interpretation. This will effect the interpretation of all the included variables, which will now be defined. K represents Dodge City, Kansas, T represents Amarillo, Texas, C represents Colorado, and W represents Washington. These locations are combined with feeder cattle futures contract months MAR = March, APR = April, MAY = May, AUG = August, SEP = September, OCT = October, and NOV = November. The combinations of location and contract month are dummy variables that represent of hedges placed in a certain market location using a given futures contract. For example, KMAR will equal 1 for a $\sigma_{m, w, c}$ resulting from hedges placed on the Dodge City, Kansas cash market using the March feeder cattle contract ($\sigma_{m = K, w, c = MAR}$) and zero otherwise. TAPR will equal 1 for $\sigma_{m = T, w, c = APR}$ and zero otherwise. The naming convention continues through all other combinations of m and c.

The effect of the interaction between w and m on hedging risk is captured in the remaining variables. These are quantitative interaction variables where K, T, C, and W once again represent the different cash markets. For a given w, HI25 represents the number of 25-pound increments heavier than contract specification is w. LO25 represents the number of 25-pound increments below contract specification. These weight variables are based on the midpoints of the weight categories. For example, the midpoint of the 600 to 650 pound group is 625 which is 3 25-pound increments outside the 700 to 800 pound contract specification. Based on this, if hedges were placed in the Dodge City, Kansas market on 600-650 pound steers ($\sigma_{m = K, w = 600 \text{ to } 650, c}$), KLO25 = 3 and all other weight, location interaction would equal zero. In the case of heavy cattle, hedged in Amarillo, TX where $\sigma_{m = T, w = 800 \text{ to } 750, c}$, THI25 = 1 and all other weight, location interaction variables would equal zero.

The interpretation of the dummy variables representing the interaction between m and c is very straightforward. The estimated coefficient on KMAY (β_3) will be the average hedging risk expected in the Dodge City, Kansas market hedging feeder cattle of any weight using the May feeder cattle contract. KHI25 will apply to cattle hedged in the Dodge City, Kansas market using any contract. Specifically, will be the change in average hedging risk per 25-pound increment above contract specifications. The interpretation of KLO25 would be the same as it applies to light cattle.

This model specification was chosen due to the evidence in previous studies that hedging risk differs by contract month (Elam, Schroeder and Mintert), location (Schroeder and Mintert) and weight (Elam, Schroeder and Mintert). This combined with the differences in the cash price series (see Table 1) and the basis of each cash price series relative to the nearby futures price[2] (reported in Table 2), indicates that there may be differences, in regard to hedging risk, across locations. Since spatial difference in hedging risk is the focus of this paper, interactions were limited to those between location and contract month and those between weight and location. Equation 7 was specified using simulated hedge results to estimate the effects of location and contract month along with those of location and weight on $\sigma_{m, w, c}$. The results of this estimation are presented in the following section.

Estimation Procedure and Results

Optimal hedge ratios were estimated for every m, w, and c using equation 1. These were initially estimated using Ordinary Least Squares. However the estimates exhibited first order autocorrelation. To correct for this, equation 1 was estimated using Generalized Least Squares (GLS). These estimates were, in general, greater than 1 for cattle lighter than the contract specification and less than l for heavier cattle. Many of the hedge ratios for feeder cattle of weights from 700 to 800 (and some slightly outside the range) were not significantly different from 1. This is to be expected since a pound for pound hedge could be appropriate for animals that match (or nearly match) the contract specifications. Since there were such a large number of hedge ratios (160) they are not reported in the paper but are available upon request from the author. The GLS estimates b_o and b_1 were then used to simulate 7, 3-month, uniform hedges for every m, w, and c via equations 4 and 5. Hedges were placed three months before the contract

[2] Ability to predict basis (Cash – Futures) determines hedging effectiveness. Since the variability of basis is different among these markets it is reasonable to expect that hedges will perform differently across markets.

month and lifted on the last day of the month preceding the contract month. Each set of hedges was then evaluated using equation 6 to arrive at a measure of hedging risk. This procedure yields an expected on $\sigma_{m, w, c}$ based on 7 years of simulated hedges. Given that the focus of this study is to identify sources of hedging risk and not simply to report that risk and that there were a large number of calculated $\sigma_{m, w, c}$ (160), these hedging risks are not reported but can be obtained from the author.

With the aforementioned estimated $\sigma_{m, w, c}$ (referred to hereafter as the hedging risk coefficient), the effects of various components of the hedge on the hedging risk coefficient can be identified and quantified. This was accomplished by estimating equation 7 using OLS. The resulting parameter estimates were found to be collectively significantly different from zero at the 1% significance level, indicating that the hedging risk coefficient could be explained, at least in part, by the m, w, and c. Specifically, the adjusted r-squared, which is reported in lieu of the r-squared statistic, indicates that about 92% of the variation in hedging risk can be explained by where the hedge is placed, what contract month is used and the weight of the steers being hedged in relation to the futures contract weight specification.

The relationships between m, c and the hedging risk coefficient are reported in Table 3. As mentioned earlier, these estimates represent average hedging risk coefficient for their respective situations. For example, a producer hedging the sale of feeder cattle of any weight in the Dodge City, Kansas cash market using the March contract could expect, on average, a hedging risk coefficient of 1.167. This estimate is in dollars per cwt. This indicates that this hedger would be within $\pm$ 1.167 dollars/cwt of his or her EP about two-thirds of the time. Other estimates in Table 3 are interpreted similarly. There are some patterns across these estimations. For instance, for every contract besides September and October, the Colorado market is the least risky in which to hedge feeder cattle. However, hedges in the Dodge City, Kansas using the September and October contracts, are the least risky. In all other months hedges in the Dodge City market is the second riskiest behind the Colorado market hedges. For half of the contract months, Washington is the most risky market in which to hedge and is never ranked higher than third among the four markets.

The effects of weight on the hedging risk are also important and were estimated as explained in the previous section. These estimates are reported in Table 4. These results indicate that when hedging off-weight cattle, lighter cattle are more risky. This is consistent with other cross hedging studies (Elam, Shcroeder and Mintert). In fact, at the 5% significance level, the results show no change in hedging risk due to hedging cattle that are heavier than the contract specifications. It should be noted however, that in this study the only class of heavy cattle examined was 800 to 850 pound steers. At the same significance level, light cattle are shown to increase in hedging risk as they are further away from contract specifications. For instance, in Dodge City, Kansas hedgers using the March contract can expect the hedging risk to increase, on average, 0.273 dollars per cwt for every 25-pound increment under 700 pounds there cattle are. Since the estimated hedging risk for the March contract in Dodge City, Kansas was 1.167, a hedger using the March contract in Dodge City to hedge 600 to 650 pound steers, which are said to be 3 25-pound increments below contract specification, could expect, on average, to realize a hedging risk coefficient of 1.886 (1.167 + 3 x 0.273) dollars per cwt. Colorado showed the largest expected increase in hedging risk due to cattle being lighter than the contract specification. In Amarillo, Texas light cattle could not be shown to have a higher expected hedging risk coefficient. Although the estimated parameter was positive, it was not significant at any reasonable confidence level. In the case of Washington, it can be said with 90% confidence that for light cattle every 25-pound increment below contract specification increases the average hedging risk by 0.205 dollars per cwt. In general, these results are consistent with expectations. Futures contracts perform differently in different locations and closeness to contract weight specification is an important factor. The next section summarizes these results and draws conclusions.

Summary and Conclusions

It has been determined that the CME feeder cattle contract can be used to manage the price risk associated with feeder cattle over a wide weight range via cross hedging. Studies have also shown that there are different risk levels associated with these hedges depending on the sex and weight of the cattle and market location. This study attempts to quantify some of these differences. Estimates show that futures contracts indeed perform very differently in different cash markets. For example, the September contract is the second least risky contract to use in the Amarillo, Texas cash market but for the Colorado cash market is the most risky of all available contracts. The effects of weight, while consistent in direction, differ in magnitude from one location to the next. Increase in average hedging risk in Colorado due to cattle being under contract weight specification by 25 pounds is twice that of the increase expected in Dodge City, Kansas. While buyers and sellers of feeder cattle in all four cash markets analyzed can reduce the price risk associated with feeder cattle, there are spatial differences among the hedging risks that they face.

Further research into why these differences are present may be warranted. However, that is beyond the scope of this paper. Knowing the risk that can be solely attributed to a futures contract and to the cash market in which a hedge is placed can potentially improve the hedging strategies of buyers and sellers of feeder cattle. Hedgers can identify the appropriate contract(s) for their respective locations and have a realistic expectation of their ability to manage price risk in that cash market.

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Table 1. Descriptive Statistics of Feeder Cattle Cash and Nearby Futures Price Series January 1993 to November 1999

	Mean ($/cwt)	Standard Dev ($/cwt)	C.V. (%)	Max ($/cwt)	Min ($/cwt)
Amarillo, Texas					
600-650 lbs.	74.63	10.25	13.73	93.00	47.86
650-700 lbs	73.59	9.66	13.13	91.50	47.06
700-750 lbs	72.25	8.72	12.06	87.50	48.33
750-800 lbs	71.56	8.32	11.62	86.50	49.02
800-850 lbs	69.73	8.08	11.59	85.77	44.04
Colorado					
600-650 lbs.	79.34	10.66	13.44	103.34	55.39
650-700 lbs	77.52	10.10	13.03	102.43	53.20
700-750 lbs	74.72	8.87	11.87	98.34	50.32
750-800 lbs	73.38	8.91	12.15	98.23	49.75
800-850 lbs	72.42	8.65	11.95	94.39	48.66
Dodge City, Kansas					
600-650 lbs.	76.78	10.47	13.63	100.00	50.13
650-700 lbs	75.10	9.44	12.57	93.75	50.32
700-750 lbs	74.22	8.82	11.88	92.25	50.89
750-800 lbs	73.37	8.41	11.46	91.90	48.88
800-850 lbs	72.52	8.14	11.23	89.75	48.86
Washington					
600-650 lbs.	74.94	11.09	14.80	97.88	50.23
650-700 lbs	73.03	10.21	13.98	92.00	48.56
700-750 lbs	70.88	9.19	12.97	89.50	50.80
750-800 lbs	69.87	8.30	11.88	89.38	48.77
800-850 lbs	69.08	8.12	11.76	86.38	48.15
Nearby Futures					
700-800 lbs	73.33	8.23	11.22	87.67	49.24

Table 2. Descriptive Statistics of the Basis (Cash – Futures) Between Feeder Cattle Cash and Nearby Futures Price Series January 1993 to November 1999

	Mean ($/cwt)	Standard Dev ($/cwt)	Max ($/cwt)	Min ($/cwt)
Amarillo, Texas				
600-650 lbs.	1.28	3.71	9.16	-10.48
650-700 lbs	0.26	3.07	7.48	-8.31
700-750 lbs	-1.08	2.34	6.91	-9.53
750-800 lbs	-1.77	2.37	7.12	-8.91
800-850 lbs	-3.60	2.83	5.61	-13.52
Colorado				
600-650 lbs.	6.01	5.49	29.33	-11.64
650-700 lbs	4.19	4.68	28.86	-5.45
700-750 lbs	1.40	2.93	18.54	-6.48
750-800 lbs	0.05	2.93	14.47	-8.74
800-850 lbs	-0.91	3.75	18.92	-12.61
Dodge City, Kansas				
600-650 lbs.	3.45	3.68	15.02	-4.94
650-700 lbs	1.77	2.37	8.77	-6.23
700-750 lbs	0.89	1.81	5.43	-5.14
750-800 lbs	0.04	1.92	4.84	-5.83
800-850 lbs	-0.81	2.07	4.03	-8.90
Washington				
600-650 lbs.	1.61	5.10	14.99	-16.07
650-700 lbs	-0.30	4.17	13.39	-11.60
700-750 lbs	-2.45	3.29	11.21	-14.11
750-800 lbs	-3.46	2.77	5.17	-10.95
800-850 lbs	-4.25	3.06	6.21	-13.69

Table 3. Estimation of Average Hedging Risk for Each CME Feeder Cattle Futures Contract Across Feeder Cattle Markets and Weight Class for Medium Frame #1 Steers

Futures Contract	Feeder Cattle Cash Market	Estimate of Hedging Risk	Standard Error
January	Amarillo, TX	4.377***	0.356
	Dodge City, KS	2.047***	0.356
	Colorado	1.720***	0.356
	Washington	4.374***	0.356
March	Amarillo, TX	1.959***	0.356
	Dodge City, KS	1.167***	0.356
	Colorado	1.072***	0.356
	Washington	1.796***	0.356
April	Amarillo, TX	1.794***	0.356
	Dodge City, KS	1.274***	0.356
	Colorado	1.027***	0.356
	Washington	2.006***	0.356
May	Amarillo, TX	1.449***	0.356
	Dodge City, KS	1.222***	0.356
	Colorado	1.214***	0.356
	Washington	2.249***	0.356
August	Amarillo, TX	1.866***	0.356
	Dodge City, KS	1.169***	0.356
	Colorado	4.527***	0.356
	Washington	2.416***	0.356
September	Amarillo, TX	1.622***	0.356
	Dodge City, KS	1.241***	0.356
	Colorado	5.368***	0.356
	Washington	2.222***	0.356
October	Amarillo, TX	2.194***	0.356
	Dodge City, KS	1.617***	0.356
	Colorado	0.729**	0.356
	Washington	1.906***	0.356
November	Amarillo, TX	1.856***	0.356
	Dodge City, KS	1.835***	0.356
	Colorado	1.218***	0.356
	Washington	1.984***	0.356

Notes: Heding risk estimates are in dollars per cwt.
***represents significance at the 0.01 level.
**represents significance ant the 0.05 level.

Table 4. Estimates of the Effects Cross Hedging Cattle Outside the Futures Contract Weight Specification on Hedging Risk Across Location

Incremental Difference From Contract Specification	Feeder Cattle Cash Market	Estimated Change in Hedging Risk Per Incremental Difference
25 lbs. Heavier	Amarillo, TX	0.008
		(0.314)
	Dodge City, KS	0.415
		(0.314)
	Colorado	0.605*
		(0.314)
	Washington	-0.048
		(0.314)
25 lbs. Lighter	Amarillo, TX	0.021
		(0.108)
	Dodge City, KS	0.273**
		(0.108)
	Colorado	0.548***
		(0.108)
	Washington	0.205*
		(0.108)

Notes: Numbers in parentheses are standard errors of the estimates
* represents significance at the 0.10 level.
** represents significance at the 0.05 level.
***represents significance at the 0.01 level.