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Hedging Feeder Steers and Heifers in the Cash-Settled Feeder Cattle Futures Market

Ted C. Schroeder and James Mintert

Recent changes in the feeder cattle futures contract specifications are expected to reduce hedging risk and may result in changes in optimal hedging levels. This study provides an estimate of feeder cattle hedge ratios associated with the new cash-settled feeder cattle futures contract and compares the levels of hedging risk present under the cash settled contract with the physical delivery contract. Hedging risks are compared for several weights of feeder steers and heifers and are analyzed across four market locations. Results indicate that hedging risk is generally, though not always, lower with cash settlement than under the physical delivery contract specifications.

Key words: feeder cattle hedging, futures markets, hedging risks.

The viability of the feeder cattle futures contract as a hedging mechanism has been a source of controversy for some time. Specifically, concern has been expressed that the large amount of basis risk present at both futures contract delivery and nondelivery points discouraged cattle producers from hedging in the feeder cattle futures market (General Accounting Office). As a result, the Chicago Mercantile Exchange significantly modified its feeder cattle futures contract specifications in 1986. Settlement via physical delivery was eliminated and cash settlement was adopted beginning with the September 1986 feeder cattle futures contract.[1] Feeder cattle futures contracts outstanding at contract expiration are settled at the Cattle-Fax U.S. feeder steer price (USFSP).[2] Cohen and Gorham predicted that basis levels would be altered and that basis risk would be significantly reduced by the introduction of cash settlement because the volatile incremental costs of making or taking delivery would be eliminated. Not only was a discrete change in the level of the feeder cattle futures price expected, but a change in the variability of the feeder cattle basis was also anticipated.

Evaluating the expected success of the feeder cattle futures specification change requires an examination of feeder cattle hedging risks. The objective of this study is to examine whether the change to cash from delivery settlement feeder cattle futures has impacted hedging risk for feeder steers and heifers. Hedge ratios and hedging risks between the delivery and cash settled contracts are compared using cash feeder cattle price data from several locations. Quantifying any changes in hedging risk resulting from the feeder cattle futures contract specification changes is important, not only to feeder cattle market participants but also to participants in other markets where cash settlement is being considered, e.g., live cattle.

Forward pricing of feeder cattle using feeder cattle futures markets frequently involves

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[1] In addition to the change to cash settlement, the contract weight specifications also changed from feeder steers weighing 575 to 700 pounds to a par weight range of 600 to 800 pounds. Several other relatively minor changes were made in the contract specifications.

[2] The USFSP is a weighted-average 600- to 800-pound feeder steer price (weighted by the number of feeder cattle in each region on 1 Jan. of each year) from four regions of the United States consisting of feeder cattle market prices from a total of 27 states (Chicago Mercantile Exchange).

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hedging feeder cattle that do not meet contract specifications. Feeder cattle that do not meet the contract weight, sex, or grade specifications are different commodities than those prescribed by the feeder cattle futures contract specifications. Cattle of different weight and sex may have different relative price patterns than the feeder cattle futures contract which may contribute to increased hedging risk. Market analysts sometimes assume a one-to-one relationship between feeder cattle futures and cash feeder cattle prices (hedge ratio of 1.0) for both sexes and across feeder cattle weight categories (Ernst et al.). As a result, the analysis of hedging risk has typically been restricted to an examination of arithmetic basis risk. However, producers using the feeder cattle futures market to forward price cattle not meeting the contract specifications are actually cross hedging, and pound-for-pound hedging will not necessarily minimize hedging risk. Analyzing whether or not hedging risk has changed, particularly for cattle that do not meet contract specifications, requires an examination of combined basis and hedge ratio risk. Evaluating the expected success of the feeder cattle futures specification change requires an examination of feeder cattle hedging risks.

Ward and Schimkat investigated the feasibility of (cross) hedging Florida feeder cattle in the Chicago Mercantile Exchange (CME) feeder cattle futures market. They concluded that the CME feeder cattle futures contract (under the physical delivery specifications) could be a useful marketing tool to help Florida feeder cattle producers reduce price risk even when the feeder cattle did not meet the futures contract's sex and weight specifications. However, Ward and Schimkat did not estimate optimal hedge ratios for feeder cattle that did not match feeder cattle futures contract specifications.

Elam calculated hedge ratios and estimated the expected changes in hedging risk under cash settlement for Arkansas feeder cattle. He concluded that hedging risk was generally lower in the cash settled feeder cattle futures contract compared to the delivery contract. However, Elam found that cash settlement resulted in an increase in hedging risk in the March, April, and May cash-settled futures contracts for cattle weighing less than 600 pounds. Elam hypothesized that results from Arkansas were likely applicable to other feeder cattle markets.

Feeder cattle hedging risks likely differ across markets. There may also be differences in hedging risk under cash settlement relative to delivery contracts, especially for feeder cattle markets that are not included in the USFSP calculation. This study examines the changes in hedging risk under cash settlement for four market locations. Three of the markets—Amarillo, Dodge City, and Kansas City—are included in the USFSP calculation. The fourth market, Illinois Direct, is not explicitly included in the USFSP series. The Amarillo, Dodge City, and Kansas City markets were selected because they are among the larger volume feeder cattle markets in the United States. The Illinois market was selected as one of the large volume market areas not included in the USFSP series.

Conceptual Issues

Cross-hedging methodology is well developed. However, general agreement does not exist regarding the appropriate technique to use when estimating hedge ratios. Witt, Schroeder, and Hayenga summarize three common approaches that have been used to estimate hedge ratios including (*a*) price level models, where the cash price is regressed on the nearby futures price; (*b*) price change models, where the change in cash price over the hedging horizon is regressed on the change in the respective futures price; and (*c*) percentage price change models, where the percentage change in cash price is regressed on the percentage change in the respective futures price. The authors argue that the choice among these techniques depends primarily upon the hedger's objective and the type of hedge.

Given the short time period for which cash-settled feeder cattle futures have been trading, the primary constraint when trying to estimate hedge ratios is the lack of data. Using a price level model to estimate hedge ratios requires a historical proxy variable for the nearby cash-settled futures contract. The historical USFSP series is a good proxy variable for the nearby cash settlement futures price since any outstanding futures contracts at expiration are settled at the USFSP. If a price difference model is used to estimate hedge ratios, data availability is a problem since a good proxy for the historical deferred cash-settled futures price does not exist. The USFSP is not a good proxy for the deferred futures price because the de-

ferred prices react to a different set of market information than the nearby prices.

Witt, Schroeder, and Hayenga suggest that when evaluating anticipatory hedges, price level models are appropriate because the hedger is primarily concerned with minimizing ending basis risk and is not concerned with price changes after the hedge is placed. Given the limited data available on cash-settled feeder cattle futures prices, the price level model is the most appropriate methodology that can currently be used to estimate the hedge ratios. Hedge ratios for each contract month were estimated using the following price level model:[3]

$$(1) \qquad C_t = b_0 + b_1 F_t + e_t,$$

where t refers to time (week), C is the cash price of the commodity being cross hedged, F is the nearby feeder cattle futures price, e is a random error term, b_0 is the regression intercept, b_1 is the hedge ratio (futures quantity/cash quantity). The model was estimated using the physical delivery feeder cattle futures prices. The model was then reestimated using the USFSP as a proxy for the cash settlement futures prices.

The potential effectiveness of cross hedging to reduce price risk has frequently been evaluated based upon within sample fit of the regression equation. Consequently, the feasibility of cross hedging has often been judged by the degree of correlation between the cash and futures market prices as expressed by the regression equation's coefficient of determination (Anderson and Danthine). However, a high coefficient of determination does not necessarily imply that cross hedging is feasible since it does not address the level of hedging risk that is present. A large coefficient of determination may be due to long-term trends in the data series and may not be representative of short-term hedging risk. Alternatively, the expected performance of a cross-hedging relationship can be evaluated via examination of the standard error of the net price received from the hedge about the expected price (Elam).[4] The standard error provides a monetary measure of the expected variability in the hedging relationship. The standard error of the net hedged price as a point forecast about the expected price can be represented as (see Elam for derivation):

$$(2) \quad Std(NP - EP) = \sigma_e \left[1 + \frac{1}{n} + \frac{(F_1 - \bar{F})^2 + \sigma_v^2}{\Sigma(F_2 - \bar{F})^2} \right]^{1/2},$$

where NP is the net price received from the hedge, EP is the expected price calculated using the estimates from equation (1), σ_e is the root-mean-squared error from the estimation of equation (1), n is the number of observations used in estimating equation (1), F_1 is the futures price at the time the hedge is placed, $F_2$is the futures price at the time the hedge is lifted, $\bar{F}$ is the mean of F_2, and σ_v is the standard error of the change in futures prices over the duration of the hedge.

This measure of hedging risk is sensitive to the sample size used to estimate the hedge ratio, the variability in the hedging relationship (σ_e), and the variance of the futures price. Hedging risk is relatively insensitive to changes in the hedge duration since only σ_v changes as the length of time the hedge is held changes. A three-month hedge was assumed for the hedging risks estimated in this study. Results would be expected to vary only slightly for different hedge lengths.

The standard error of the change in futures price (σ_v) was calculated using the physical de-

[3] The price level model assumes that the hedger is concerned only with minimizing the variance about the expected return in an anticipatory hedge. Using the terminology of Witt, Schroeder, and Hayenga, the objective of the hedger is to minimize the variance of the following target value:

$$Target\ Value = -X_f F_1 - E[-X_f F_2 - X_c C_2],$$

where X_f is the quantity of futures commodity, F_1 is the futures price at the time the hedge is placed, E is an expectations operator, F_2 is the futures price at the time the hedge is lifted, X_c is the quantity of cash commodity, and C_2 is the price of the cash commodity when the cash transaction occurs. The variance of the target value is

$$\text{Var}\ (Target\ Value) = X_f^2 \sigma_{f2}^2 + X_c^2 \sigma_{c2}^2 + 2X_f X_c \sigma_{c2f2},$$

where σ_{f2}^2, σ_{c2}^2, and σ_{c2f2} are the variance and covariance of ending futures and cash prices, respectively, at the time the cash transaction is completed. Minimizing the variance of the target value by choosing the futures position (X_f) implies that the hedge ratio is

$$\frac{-X_f}{X_c} = \frac{\sigma_{c2f2}}{\sigma_{f2}^2},$$

which is the regression coefficient of cash price regressed on the nearby futures price during the period when the hedger would be lifting the hedge.

[4] The expected (hedged) price is the predicted price obtained by substituting the actual futures price at time t into equation (1) and calculating the expected cash price (ignoring hedging costs),

$$Expected\ Price = \hat{b}_0 + \hat{b}_1 F_1.$$

The net price received is the cash price plus any gain or loss in the futures market (again ignoring hedging hosts),

$$Net\ Price = C_2 + \hat{b}_1(F_1 - F_2).$$

livery feeder cattle futures prices (Jan. 1977 through Aug. 1986). This estimate is appropriate since the variance of the cash-settled feeder cattle futures prices in the long run are not expected to differ from that of the physical delivery contracts because both should react similarly to changing market fundamentals (Elam).

Data

Weekly feeder cattle prices from the Amarillo, Texas; Dodge City, Kansas; Kansas City, Missouri; and Illinois Direct markets covering the January 1977 through December 1987 period were collected. Feeder steer and heifer prices included the following U.S. Department of Agriculture (USDA)-quoted weight categories: (*a*) 300 to 400 pounds, (*b*) 400 to 500 pounds, (*c*) 500 to 600 pounds, (*d*) 600 to 700 pounds, and (*e*) 700 to 800 pounds. Weekly average closing prices from the CME's nearby delivery feeder cattle futures were used to estimate hedge ratios over the January 1977 through 15 August 1986 period (August was the last physical delivery contract traded). Similarly, the Cattle-Fax weekly USFSP was used as a proxy for the nearby weekly average closing cash-settled feeder cattle futures price over the same historical period. The nearby futures contract was defined to cover the period from the fifteenth day of the month prior to contract expiration to the fifteenth day of the expiration month. Four weekly observations for each year for each contract month were used in the regression models. The number of observations used to estimate the models ranged from twenty-seven to forty-three, differing by contract month, sex, and market location. The weekly average CME cash-settled feeder cattle closing futures prices were used to calculate out-of-sample percentage root-mean-squared errors of the estimated hedging relationships during the September 1986 through December 1987 period.

Results and Discussion

The hedge ratios for cross-hedging steers and heifers of various weights in the feeder cattle futures market were estimated via equation (1). Hedge ratios were estimated separately for each market location and contract month by feeder cattle weight and sex. Hedge ratios for both the USFSP and the actual physical delivery feeder cattle futures prices were estimated. Changes in hedge ratios and hedging risks expected to arise from the futures contract's specification changes can thus be evaluated.

The cash settlement hedge ratios were initially estimated using ordinary least squares (OLS). First-order autocorrelation of the residuals was present in the OLS estimation. The equations were reestimated using generalized first-order autocorrelation adjusted least squares (GLS). The GLS estimated hedge ratios and intercepts for 400- to 500-pound and 700- to 800-pound steers and heifers are reported in table 1. Estimated hedging relationships for the remaining feeder cattle weight categories are not reported but can be obtained from the authors. Differences in the estimated hedge ratios using the two different estimation techniques were relatively small. The models explained most of the variation in cash prices with R-squared values ranging from .92 to .99.

The majority of the hedge ratios for feeder steers weighing less than 600 pounds were significantly greater than one at the 5% level. This was expected since light weight feeder cattle experience larger price changes in response to changing input and output prices than heavier weight feeder cattle (Buccola; Marsh). Hedge ratios larger than one indicate that the hedger needs a larger position in the feeder cattle futures market than the cash market to minimize hedging risk. The hedge ratios were smaller for feeder cattle that more closely matched the feeder cattle futures contract weight specifications. Hedge ratios for 600- to 800-pound feeder steers were, in general, not significantly different from one, which was expected because both the weight and sex match the feeder cattle futures contract specifications. Systematic differences in hedging relationships across markets were not detected.

Feeder cattle hedge ratios for a given weight range differed by sex. However, hedge ratios for steers of a given weight and heifers weighing 100 pounds less were similar. For instance, the January contract 600- to 700-pound heifer hedge ratios ranged from .94 to .96 and the corresponding 700- to 800-pound January steer hedge ratios ranged from .96 to .98. Heifer prices appear to be more closely correlated with prices of heavier-weight steers. This could occur because heifers tend to mature at lighter weights than steers. Because steers and lighter weight heifers reach slaughter weight at ap-

Table 1. Cash Settlement Relationships for Hedging Feeder Cattle in Feeder Cattle Futures, Selected Locations, January 1977 through August 1986

Cash Commodity and Contract Month	Amarillo[a]		Dodge City		Kansas City		Illinois Direct	
	USFSP[b]	Intercept	USFSP	Intercept	USFSP	Intercept	USFSP	Intercept
Steers 4/500								
Jan	1.14**	−1.99	1.26**	−6.80	1.27**[c]	−10.03	1.20**	−6.54
	(0.05)*	(3.08)	(0.09)*	(5.61)	(0.06)*	(3.72)*	(0.09)*	(5.54)
Mar	1.38**	−14.19	1.24**	−4.50	1.29**	−8.56	1.17	−5.79
	(0.06)*	(4.05)*	(0.06)*	(3.97)	(0.07)*	(4.37)	(0.08)*	(5.34)
Apr	1.27**	−6.85	1.20**	−0.98	1.24**	−4.35	1.09	0.38
	(0.06)*	(3.97)	(0.06)*	(4.16)	(0.04)*	(3.00)	(0.06)*	(3.88)
May	1.40**	−12.19	1.27**	−3.10	1.29**	−5.73	1.30**	−11.62
	(0.07)*	(4.46)*	(0.07)*	(4.69)	(0.06)*	(3.90)	(0.08)*	(4.86)*
Aug	1.36**	−12.55	1.31**	−9.06	1.33**	−11.75	1.30**	−11.44
	(0.08)*	(5.14)*	(0.13)*	(7.89)	(0.10)*	(6.04)	(0.08)*	(5.10)*
Sep	1.21**	−5.11	1.29**	−6.99	1.44**	−15.85	1.31**	−12.02
	(0.08)*	(4.95)	(0.09)*	(5.89)	(0.07)*	(4.97)*	(0.07)*	(4.48)*
Oct	1.28**	−9.73	1.27**	−6.77	1.34**	−10.65	1.34**	−12.74
	(0.06)*	(4.04)*	(0.07)*	(4.37)	(0.07)*	(4.54)*	(0.08)*	(4.76)*
Nov	1.26**	−7.07	1.20**	−3.25	1.30**	−10.21	1.37**	−14.18
	(0.07)*	(4.53)	(0.07)*	(4.40)	(0.06)*	(3.63)*	(0.07)*	(5.02)*
Steers 7/800								
Jan	0.96	3.40	0.99	1.93	0.99	0.92	0.98	0.24
	(0.03)*	(1.63)*	(0.02)*	(1.04)	(0.02)*	(1.21)	(0.05)*	(2.95)
Mar	0.98	1.86	0.98	2.54	0.94**	4.16	0.96	1.09
	(0.02)*	(1.46)	(0.02)*	(1.12)*	(0.02)*	(1.50)*	(0.05)*	(3.00)
Apr	1.02	−0.31	1.00	0.92	0.97	2.29	0.94	2.72
	(0.02)*	(1.23)	(0.01)*	(0.88)	(0.02)*	(1.28)	(0.04)*	(2.48)
May	1.03	−2.20	0.98	1.82	0.97**	3.07	1.01	0.30
	(0.02)*	(1.46)	(0.02)*	(1.38)	(0.01)*	(0.84)*	(0.05)*	(2.91)
Aug	1.02	−1.29	0.96	3.27	0.98	1.51	1.04	−2.16
	(0.03)*	(1.96)	(0.03)*	(1.75)*	(0.03)*	(1.86)	(0.04)*	(2.47)
Sep	0.92**	4.77	0.95	3.91	0.91**	6.40	0.98	1.07
	(0.03)*	(1.90)*	(0.03)*	(1.60)*	(0.03)*	(1.65)*	(0.04)*	(2.63)
Oct	0.96	2.10	0.98	1.81	0.97	2.45	1.06**	−2.85
	(0.02)*	(1.46)	(0.02)*	(1.00)	(0.02)*	(1.24)	(0.03)*	(1.56)
Nov	0.97	1.40	0.97	2.89	1.01	0.78	1.02	−0.31
	(0.03)*	(1.75)	(0.02)*	(1.41)*	(0.02)*	(1.12)	(0.03)*	(1.85)
Heifers 4/500								
Jan	1.03	−5.87	1.16**	−11.88	1.17**	−14.81	1.08	−7.62
	(0.04)*	(2.67)*	(0.08)*	(4.98)*	(0.05)*	(3.31)*	(0.09)*	(5.43)
Mar	1.17**	−11.99	1.28**	−17.71	1.19**	−13.91	1.07	−7.24
	(0.05)*	(3.33)*	(0.06)*	(3.74)*	(0.05)*	(3.32)*	(0.08)*	(5.12)
Apr	1.13**	−9.05	1.15**	−9.21	1.14**	−9.75	0.99	−0.68
	(0.05)*	(3.02)*	(0.05)*	(3.53)*	(0.05)*	(2.97)*	(0.06)*	(3.61)
May	1.29**	−17.50	1.12	−6.19	1.15**	−9.23	1.13**	−8.04
	(0.06)*	(4.03)*	(0.06)*	(3.85)	(0.05)*	(3.19)*	(0.05)*	(3.41)*
Aug	1.15**	−11.64	1.14	−9.28	1.13	−9.49	1.15**	−9.95
	(0.07)*	(4.62)*	(0.11)*	(6.89)	(0.07)*	(4.20)*	(0.07)*	(4.26)*
Sep	1.11	−9.29	1.20**	−12.88	1.12	−8.28	1.17**	−11.07
	(0.06)*	(3.86)*	(0.10)*	(6.08)*	(0.07)*	(4.53)	(0.06)*	(3.82)*
Oct	1.10	−9.27	1.14**	−10.26	1.14**	−10.94	1.20**	−12.73
	(0.06)*	(3.76)*	(0.06)*	(4.01)*	(0.06)*	(3.59)*	(0.07)*	(4.33)*
Nov	1.08	−8.13	1.11	−8.42	1.15**	−12.60	1.19**	−11.91
	(0.06)*	(3.81)*	(0.08)*	(5.05)	(0.04)*	(2.90)*	(0.07)*	(4.72)*

Table 1. Continued

Cash Commodity and Contract Month	Amarillo[a]		Dodge City		Kansas City		Illinois Direct	
	USFSP[b]	Intercept	USFSP	Intercept	USFSP	Intercept	USFSP	Intercept
Heifers 7/800								
Jan	0.93	−1.89	0.90**[c]	1.67	0.89**	0.49	[d]	
	(0.05)*	(3.01)	(0.03)*	(1.86)	(0.02)*	(1.12)		
Mar	0.94	−0.98	0.91**	1.06	0.82**	5.58		
	(0.06)*	(3.91)	(0.02)*	(1.27)	(0.03)*	(2.10)*		
Apr	0.89**	1.98	0.96	−1.61	0.77**	8.45		
	(0.06)*	(3.82)	(0.03)*	(2.04)	(0.03)*	(2.03)*		
May	0.89**	1.23	0.97	−2.21	0.82**	6.02		
	(0.06)*	(3.53)	(0.02)*	(1.50)	(0.03)*	(1.99)*		
Aug	0.88	1.71	0.90**	2.05	0.86**	3.53		
	(0.09)*	(5.52)	(0.04)*	(2.20)	(0.03)*	(2.07)		
Sep	0.81**	5.31	0.88**	2.97	0.81**	6.63		
	(0.05)*	(3.02)	(0.02)*	(1.49)	(0.03)*	(2.04)*		
Oct	0.94	−3.43	0.91**	0.67	0.85**	3.91		
	(0.04)*	(2.51)	(0.02)*	(1.55)	(0.03)*	(1.78)*		
Nov	0.86**	0.71	0.87**	2.35	0.88**	2.19		
	(0.03)*	(1.88)	(0.02)*	(1.53)	(0.02)*	(1.23)		

[a] Standard errors are in parentheses beneath the respective parameter estimates.
[b] USFSP is the weekly cattle-fax U.S. feeder steer price used as proxy for the weekly average cash settlement contract feeder cattle futures price.
[c] Single asterisk indicates estimated coefficient significantly different from zero at the .05 level; double asterisk indicates estimated hedge ratio significantly different from one at the .05 level.
[d] Cash price data not reported, last two columns, rest of table.

proximately the same time, their prices react in a similar manner to new information.

Hedge ratios were also estimated using the physical delivery feeder cattle futures contract prices to provide a comparison with the hedge ratios estimated using the USFSP series. The hedge ratios estimated using the physical delivery feeder cattle contract prices are reported in table 2 for the 400- to 500-pound and 700- to 800-pound weight categories. The physical delivery hedge ratios are generally 10% to 15% smaller than the corresponding hedge ratios estimated using the USFSP series. A comparison of the hedge ratios estimated using the two different price series indicates that 87 of the 296 estimated cash settlement hedge ratios are significantly different (at the 10% level) from those estimated using the physical delivery futures contract.[5] Under-hedging would frequently occur if feeder cattle hedgers use the same hedge ratios on the cash-settled futures contracts as they did under the old physical delivery system contracts. Elam also found that the physical delivery hedge ratios were typically smaller than the cash settled hedge ratios.

The hedging risk was estimated using equation (2) evaluated at the mean nearby futures price for both the cash-settled and the physical delivery futures contracts. For almost all of the contract months and weight ranges, the cash-settled feeder cattle futures had lower hedging risk than the physical delivery futures contract (table 3). More than 50% of the reductions in hedging risk were significantly different from zero at the .05 level. These reductions in hedging risk attributable to cash settlement were similar across the three markets included in the USFSP calculation as well as the Illinois Direct market, which is not included in the USFSP series.

Heavier weight (600 pounds and over) feeder cattle had the largest reductions in hedging risk. The majority of the heavier weight cattle had significantly (at the .10 level) lower hedging risk under cash settlement than was present for physical delivery feeder cattle futures. The reductions in hedging risk attributable to the

[5] The test used to compare the hedge ratios was to estimate the models restricting the slope coefficients to be equal across the two models while allowing the other parameters to vary. An F-test was used to compare the restricted model's sum of squared error to the pooled sum of squared error from the unrestricted models. This procedure is similar to a structural change F-test as outlined by Johnston, pp. 207–25.

Table 2. Delivery Relationships for Hedging Feeder Cattle in Feeder Cattle Futures, Selected Locations, January 1977 through August 1986

Cash Commodity and Contract Month	Amarillo[a]		Dodge City		Kansas City		Illinois Direct	
	FP[b]	Intercept	FP	Intercept	FP	Intercept	FP	Intercept
Steers 4/500								
Jan	1.08	−3.29	1.15	−4.80	1.16**[c]	−9.26	1.13	−7.20
	(0.06)*	(3.84)	(0.09)*	(6.25)	(0.05)*	(3.59)*	(0.10)*	(6.85)
Mar	1.31**	−15.00	1.19**	−5.51	1.23**	−9.19	1.11	−6.65
	(0.06)*	(4.32)*	(0.06)*	(4.25)	(0.07)*	(4.85)	(0.09)*	(5.89)
Apr	1.20**	−6.28	1.10	0.93	1.14**	−1.63	0.99	2.53
	(0.05)*	(3.60)*	(0.06)*	(4.16)	(0.04)*	(3.14)	(0.06)*	(4.05)
May	1.33**	−12.19	1.23**	−4.27	1.21**	−4.47	1.26**	−12.60
	(0.07)*	(4.42)*	(0.07)*	(4.68)	(0.06)*	(4.08)	(0.07)*	(5.02)*
Aug	1.05	2.75	1.08	1.19	1.06	1.41	1.15	−6.43
	(0.08)*	(5.05)	(0.09)*	(6.48)	(0.09)*	(6.25)	(0.09)*	(6.04)
Sep	1.13	−3.96	1.23**	−7.27	1.34**	−14.37	1.26**	−12.78
	(0.09)*	(5.70)	(0.10)*	(6.79)	(0.09)	(5.93)*	(0.08)*	(5.48)*
Oct	1.21**	−9.34	1.20**	−6.35	1.25**	−9.83	1.27**	−13.03
	(0.08)*	(5.03)	(0.08)*	(5.27)	(0.09)*	(5.85)	(0.09)*	(6.38)*
Nov	1.18**	−7.44	1.12	−2.73	1.22**	−10.44	1.27**	−14.05
	(0.09)*	(5.03)	(0.08)*	(5.10)	(0.07)*	(4.50)*	(0.09)*	(6.22)*
Steers 7/800								
Jan	0.85**	6.41	0.90**	3.34	0.89**	2.62	0.93	−1.00
	(0.04)*	(2.75)*	(0.03)*	(2.06)	(0.03)*	(2.10)	(0.06)*	(4.10)
Mar	0.95	0.25	0.94**	1.49	0.90**	3.01	0.92	0.07
	(0.03)*	(2.15)	(0.03)*	(1.82)	(0.03)	(2.25)	(0.05)*	(3.59)
Apr	0.95**	0.87	0.94**	1.16	0.88**	5.04	0.84**	6.05
	(0.02)*	(1.56)	(0.03)*	(1.83)	(0.03)*	(2.15)*	(0.04)*	(3.01)*
May	0.98	−1.39	0.94**	1.94	0.92**	3.42	0.94	1.35
	(0.02)*	(1.46)	(0.03)*	(1.66)	(0.03)*	(1.68)*	(0.05)*	(3.57)
Aug	0.92**	0.51	0.88**	4.13	0.89**	3.77	0.92	1.53
	(0.03)*	(1.93)	(0.03)*	(1.83)*	(0.03)*	(2.06)	(0.05)*	(3.58)
Sep	0.89**	3.29	0.93**	2.32	0.89**	4.17	0.96	−0.75
	(0.03)*	(2.08)	(0.03)*	(1.82)	(0.03)*	(1.82)*	(0.05)*	(3.05)
Oct	0.94**	0.29	0.96	0.55	0.95	0.95	1.02	−3.66
	(0.03)*	(1.64)	(0.02)*	1.55	(0.03)*	(1.77)	(0.04)*	(2.64)
Nov	0.91**	0.87	0.91**	2.28	0.93**	1.24	0.95	0.17
	(0.02)*	1.34	(0.02)*	(1.21)	(0.03)*	(1.79)	(0.04)*	(2.58)
Heifers 4/500								
Jan	0.94	−4.65	1.07	−10.74	1.06	−13.34	1.03	−9.43
	(0.05)*	(3.18)	(0.07)*	(5.15)*	(0.04)*	(3.38)*	(0.09)*	(6.11)
Mar	1.11**	−12.62	1.21**	−17.75	1.13**	−14.65	1.03	−8.53
	(0.05)*	(3.64)*	(0.06)*	(4.42)*	(0.06)*	(3.79)*	(0.08)*	(5.46)
Apr	1.05	−7.84	1.07	−8.59	1.05	−7.99	0.93	0.08
	(0.04)*	(3.01)*	(0.05)*	(3.20)*	(0.04)*	(2.80)*	(0.05)*	(3.48)
May	1.21**	−16.20	1.06	−5.66	1.07	−7.78	1.07	−7.34
	(0.06)*	(4.30)*	(0.06)*	(4.10)	(0.05)*	(3.59)*	(0.06)*	(3.73)
Aug	0.95	−2.93	0.88	3.26	0.90	0.71	1.00	−3.77
	(0.07)*	(4.37)	(0.08)*	(5.57)	(0.07)*	(4.54)	(0.08)*	(5.53)
Sep	1.06	−9.88	1.18	−15.88	1.08	−9.24	1.13**	−12.39
	(0.06)*	(4.16)*	(0.10)*	(6.64)*	(0.07)*	(4.46)*	(0.06)*	(4.30)*
Oct	1.05	−9.64	1.08	−9.87	1.07	−10.44	1.14	−12.74
	(0.07)*	(4.53)*	(0.08)*	(5.05)	(0.07)*	(4.69)*	(0.08)*	(5.46)*
Nov	1.02	−9.10	1.03	−7.94	1.07	−12.51	1.09	−10.88
	(0.06)*	(4.01)*	(0.09)*	(5.79)	(0.06)*	(3.80)*	(0.08)*	(5.63)

Table 2. Continued

Cash Commodity and Contract Month	Amarillo[a]		Dodge City		Kansas City		Illinois Direct	
	FP[b]	Intercept	FP	Intercept	FP	Intercept	FP	Intercept
Heifers 7/800								
Jan	0.83**	0.77	0.80**[c]	4.29	0.81**	1.65	[d]	
	(0.04)*	(2.75)	(0.04)*	(2.81)	(0.02)*	(1.45)		
Mar	0.85**	2.26	0.88**	0.15	0.77**	5.78		
	(0.05)*	(3.59)	(0.02)*	(1.65)	(0.05)*	(3.05)		
Apr	0.73**	10.71	0.95	−4.25	0.66**	12.47		
	(0.05)*	(3.75)*	(0.04)*	(2.82)	(0.04)*	(2.63)		
May	0.77**	6.88	0.92	−2.29	0.77**	7.12		
	(0.06)*	(3.79)	(0.04)*	(2.58)	(0.04)*	(2.64)*		
Aug	0.89**	−2.50	0.81**	3.74	0.80**	3.92		
	(0.07)*	(4.45)	(0.04)*	(2.33)	(0.03)*	(2.14)		
Sep	0.81**	2.99	0.86**	1.07	0.80**	4.32		
	(0.03)*	(2.07)	(0.01)*	(0.99)	(0.03)*	(1.97)*		
Oct	0.97	−8.27	0.90**	−1.75	0.82**	2.67		
	(0.04)*	(2.89)*	(0.02)*	(1.74)	(0.03)*	(1.77)		
Nov	0.82**	−1.20	0.82**	2.10	0.82**	2.33		
	(0.05)	(3.67)	(0.02)*	(1.22)	(0.02)*	(1.62)		

[a] Standard errors are in parentheses beneath the respective parameter estimates.
[b] FP refers to the weekly average nearby delivery settlement contract feeder cattle futures price.
[c] Single asterisk indicates estimated coefficient significantly different from zero at the .05 level; double asterisk indicates estimated hedge ratio significantly different from one at the .05 level.
[d] Cash price data not reported, last two columns, rest of table.

change to cash settlement were frequently greater than 15%. A noted exception occurred at Dodge City where 600- to 700- and 700- to 800-pound heifers in September had a higher hedging risk with the cash settled futures than with the delivery contract. The differences in hedging risk for these two heifer weight classes in September could be associated with the increased demand for breeding herd replacements in the fall.

Out-of-sample percentage root-mean-squared errors (RMSE of the net prices about the expected prices as a percent of the respective 15-month average feeder cattle price) of the cash settlement models were calculated to examine the performance of the USFSP-estimated hedging relationships during the short period feeder cattle futures have been trading under the cash settlement specifications. Model performance was examined over the September 1986 through December 1987 period. Over this limited amount of time, the models performed well in out-of-sample testing. Percentage root-mean-squared errors ranged from 3% to 5% of the average cash price for steers weighing less than 500 pounds, while similar weight heifers had percentage RMSE's varying from approximately 4% to 7%. As expected, steers meeting feeder cattle futures contract weight specifications (600–800 lbs.) had lower percentage RMSE's, ranging from less than 2% to about 3%. Though limited in scope, these results provide evidence that the USFSP series is an appropriate proxy for the cash-settled feeder cattle futures prices near contract expiration.

Conclusions

One of the principal motivations for the introduction of cash-settled feeder cattle futures contracts was to reduce basis risk. This study examined expected changes in hedging risk attributable to the adoption of cash settlement. The USFSP (cash settlement futures) hedging risk estimates were generally smaller than hedging risks estimated using the physical delivery futures. The reduction in hedging risk was greatest for feeder steers meeting futures contract weight specifications; however, reductions in hedging risk were also common for other weight classes and for heifers. Hedging risk reductions were relatively consistent across

Table 3. Percentage Change in Hedging Risk: Cash Settlement versus Delivery Feeder Cattle Futures Contract, January 1977 through August 1986

Cash Commodity and Contract Month	Amarillo	Dodge City	Kansas City	Illinois Direct
	(%)			
Steers 3/400				
Jan	11.11*[a]	1.45	−3.86	[b]
Mar	−12.23*	−12.90*	−11.64	
Apr	−0.60	−4.97	2.35	
May	−2.42	−4.03	−2.95	
Aug	−3.86	−18.05*	−10.11*	
Sep	−9.09*	−6.13	−3.35	
Oct	−12.18*	−9.16*	−11.14*	
Dec	−7.36	−7.20	−15.40*	
Steers 4/500				
Jan	7.86	1.47	7.18	−1.13
Mar	−7.83	−8.84	−11.76*	−11.88*
Apr	−0.63	−2.40	−6.89	−2.93
May	1.27	−8.22*	−3.48	0.27
Aug	−12.04*	−5.43	−13.93*	−2.95
Sep	−9.32*	−8.12	−13.49*	−7.23
Oct	−161.6*	−15.24*	−18.27*	−17.79*
Dec	−6.41	−9.95*	−12.29*	−14.77*
Steers 5/600				
Jan	−12.94*	−7.17	11.11	−1.65
Mar	−19.52*	−14.17*	−13.67*	−13.48*
Apr	−7.10	2.89	−9.80*	1.62
May	−6.63	−12.42*	−6.79	−7.78*
Aug	−18.74*	−8.76	−9.06	−9.86
Sep	−12.34*	−6.69	−8.41	−10.63*
Oct	−19.06*	−12.92*	−22.96*	−23.54*
Dec	−7.60	−10.10*	−17.37*	−18.12*
Steers 6/700				
Jan	−30.62*	−19.73*	−7.81	−0.54
Mar	−15.70*	−4.76	−12.23*	−12.35*
Apr	−16.03*	−15.57*	−6.66	−1.58
May	−14.47	−6.39	−15.17*	−10.08*
Aug	−24.27*	−19.63*	−35.27*	−14.18*
Sep	−17.00*	−14.82*	−15.28*	−10.50*
Oct	−26.87*	−17.51*	−28.79*	−24.40*
Dec	−9.16	−15.32*	−17.77*	−20.33*
Steers 7/800				
Jan	−21.66*	−21.50*	−9.50	−1.62
Mar	−6.92	−16.60*	−17.33*	−15.04*
Apr	−15.31*	−17.40*	−9.37*	−3.59
May	−14.23*	−9.74	−19.61*	−9.06*
Aug	−7.67	−12.76*	−12.11*	−11.70*
Sep	−11.08*	−13.27*	−16.09*	−3.73
Oct	−12.52*	−21.58*	−18.85*	−25.12*
Dec	−3.28	−7.44	−24.15*	−15.95*
Heifers 3/400				
Jan	8.10	1.87	13.05*	
Mar	−10.77	−11.99	−14.52*	
Apr	3.73	0.36	4.12	
May	−0.76	−2.95	−2.17	
Aug	10.59*	−17.24	−7.32	
Sep	−2.74	8.40	−0.14	
Oct	−13.12*	−12.71*	−18.61*	
Dec	4.40	−5.24	−16.51*	

Table 3. Continued

Cash Commodity and Contract Month	Amarillo	Dodge City	Kansas City	Illinois Direct
Heifers 4/500				
Jan	2.77	2.47	9.56	2.36
Mar	−10.52	−15.77*	−12.25	−7.77
Apr	−3.82	−2.04	1.00	−0.11
May	−6.32	−7.76*	−8.44	−3.60
Aug	−6.46	1.84	−16.86*	−5.96
Sep	−2.37	−0.56	2.43	−2.79
Oct	−12.24*	−17.29*	−18.69*	−15.16*
Dec	−0.76	−8.02*	−15.85*	−12.31*
Heifers 5/600				
Jan	0.88	−5.38	−0.79	1.27
Mar	−15.51*	−10.82	−19.74*	−9.96*
Apr	−12.30*	−10.24*	−8.69*	−0.14
May	−9.42	−16.75*	−5.70	−4.07
Aug	−18.94*	−23.58*	−21.12*	−6.04
Sep	−14.30*	3.78	−6.72	−3.09
Oct	−21.44*	−13.48*	−20.60*	−16.86*
Dec	−13.31*	−12.70*	−22.68*	−11.93*
Heifers 6/700				
Jan	−7.81	−18.48*	7.30	0.29
Mar	−23.09*	−19.53*	−24.90*	−13.68*
Apr	−31.02*	−12.74*	−12.61*	−1.87
May	−13.19*	−14.80*	−12.75*	−2.92
Aug	−24.56*	−12.42*	−10.87*	−14.35*
Sep	−13.30*	15.24*	−10.46*	−6.26
Oct	−18.77*	−8.39	−18.73*	−15.75
Dec	−15.38*	−11.22*	−24.33*	−12.74
Heifers 7/800				
Jan	−1.39	−23.15*	−0.52	
Mar	−1.26	−9.64*	−21.42*	
Apr	−5.70	−10.74*	−14.74*	
May	−10.35*	−18.93*	−12.95*	
Aug	−17.15*	−8.74	−9.98	
Sep	5.96	18.88*	−11.00*	
Oct	−8.90	−4.43	−6.26	
Dec	−17.10*	−2.60	−17.42*	

[a] Asterisk indicates significantly different from zero at the .05 level.
[b] Blanks indicate cash price data not reported.

the four markets (Amarillo, Dodge City, Kansas City, and Illinois Direct) examined in this study.

Although most of these results are consistent with Elam's findings, they do differ in one respect. Elam concluded that, for Arkansas feeder cattle weighing less than 600 pounds, hedging risk was as much as 30% greater for the March, April, and May cash-settled contracts relative to the physical delivery futures contracts. Elam hypothesized that Arkansas feeder cattle hedging risk patterns would be representative of feeder cattle markets in general. However, hedging risk for light weight steers during the spring was generally smaller, and never significantly greater, under cash settlement compared to delivery futures in the four markets examined in this study. It should be noted that the reduction in hedging risk under cash settlement for light weight feeders was generally smallest during the spring. Because our techniques were similar, the observed discrepancies in spring hedging risk changes in Arkansas relative to the other locations are likely attributable to market differences.

Minimizing hedging risk in cash-settled feeder cattle futures often requires buying or selling a futures quantity that is different from the hedger's cash quantity, particularly for feeder cattle not meeting the contract specifications. Hedge ratios for lighter weight feeder cattle were generally significantly greater than

one. Our results suggest that optimal hedge ratios will increase by 10% to 15% under cash settlement relative to physical delivery. Under-hedging would frequently occur if feeder cattle hedgers used the same hedge ratios under the cash-settled contract as they did under the physical delivery contract.

Overall, the results suggest that the adoption of cash settlement will generally lead to a reduction in feeder cattle hedging risk. It is possible that hedging risk reductions may differ across other market locations not examined here. The relatively large reductions in hedging risk estimated at the four markets included in this study indicate that increased use of feeder cattle futures by hedgers is likely to occur.

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