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**Basis Convergence in Cattle Contracts Before
and After Changes to Delivery Specifications**

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Selected Paper

Western Agricultural Economics Association meetings

Reno, NV

July 1997

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Abstract

Cattle markets have undergone considerable change, affecting basis convergence. Since convergence is essential to the market's risk transfer role, revised delivery specifications have been a necessary response. However, basis analysis shows little resulting improvement. Evidence from feeder cattle suggests that cash settlement may not achieve satisfactory results for live cattle.

Basis Convergence in Cattle Contracts Before and After Changes to Delivery Specifications

Livestock markets have undergone considerable change in recent years, a trend that is likely to continue for the foreseeable future. These changes have resulted in several revisions to the cattle contracts in an effort to keep futures market delivery specifications current. This paper reviews four principle contract revisions, two for feeder cattle and two for live cattle. Impacts of these revisions on basis convergence will be considered through a summary of past studies as well as through comparative statistics included here. Results may provide guidance for evaluating proposed changes to the live cattle contract and to an industry debate over contract specifications.

Changes to Cattle Delivery Specifications

Futures markets serve two primary roles: to aid in the price discovery process, and to provide a mechanism for risk transfer. To effectively transfer risk, “the differential between the futures contract and the underlying cash commodity contract, known as the basis, must be predictable and less variable than the cash price” (Schroeder et al., p. 49.). Hence, basis convergence is critically important to performing this role.

Generally, better convergence occurs when futures market specifications reflect current industry practices. As the CME states in their introductory hedging materials, “Because the terms and conditions of a futures contract are set to encompass the mainstream of the commodity in the marketplace, convergence between futures prices and major cash market values can readily occur.” (CME, 1994, pg. 8). As cash methods

change, futures specifications must also change to keep pace (CME, 1994). Often these changes are in response to hedger needs or new production patterns (Leuthold).

In feeder cattle, these needs resulted in the adoption of cash settlement, starting with the September 1986 contract. Contracts before this date were settled via physical delivery to one of several delivery points. Elam (1988) reports that commercial interest in the contract was reduced by three problems: 1) disputes associated with grading, 2) inconsistencies between contract and cash market discounts for non-par grades, weights, and locations, and 3) large basis risk. Correcting these problems through physical delivery was hampered by the diverse nature of this market. High delivery cost combined with dissatisfaction with delivery location on the part of long hedgers resulted in poor market participation (Kenyon, Bainbridge, and Ernst). Faced with a less credible threat of delivery due to weak participation, convergence of cash and futures became suspect. Thus, cash settlement of the feeder cattle contract was initiated.

The contract was again revised for the January 1993 delivery period. These revisions made the contract more consistent with newer marketing practices. Trading units were increased from 44,000 to 50,000 pounds and a new settlement index was adopted. This new index was expected to improve performance by: 1) narrowing the specifications in terms of uniformity, weight range, and geographic location, 2) reflecting market trends better due to volume-weighting of prices, and 3) basing settlement on publicly available information. (CME Commodity Insights).

The live cattle contract was also undergoing change during this period. Changes were partially fueled by increasing concentration in the meat packing industry. Between

1980 and 1994, the four largest firms increased their percentage of steer and heifer slaughter from 36% to 82% (Grain Inspection, Packers and Stockyards Administration, pg. 1). But similar to feeder cattle, much of the problem was attributable to a delivery system that discouraged participation by long hedgers. In the case of delivery, location decisions rested with those holding the short position. This fact left packers with the risk that delivery could occur some distance from their facilities (Purcell and Hudson). A second risk to long hedgers involve redelivered cattle. Because of the delivery window, one set of cattle could be used for multiple deliveries as ownership passed between longs and shorts. The added handling and disruption to feeding adversely affected their value.

In an effort to reduce these concerns and increase long hedger participation in delivery, the CME began a certificate-based delivery process with the December 1983 contract. Under this system, a short who wished to make delivery would issue a certificate that indicated delivery location. The long assigned to receive delivery could accept this certificate or retender it by paying a \$1.50/cwt fee, which would be transferred to the long accepting delivery. Thus, the certificate is passed among traders instead of cattle, removing the redelivery issue. Although this system is beneficial to longs, it penalized shorts. Once a certificate was issued, the short had minimal opportunity to reclaim it. Rather, the short waited on a slower system to establish delivery and risked that benefits to delivery would be exhausted during the process. This delay was especially discouraging to traders seeking arbitrage profits (Purcell and Hudson).

The move to certificate delivery did not eliminate concern over the live cattle contract. A survey of industry members during the summer of 1987 indicated several

concerns with the delivery process (Kahl, Hudson, and Ward). These concerns included: 1) grading inaccuracies leading to increased delivery at more lenient locations, 2) dumping of lower quality cattle, 3) deliveries outside of the primary feeding areas, and 4) contract specifications that disallow certain breeds and limit deliverable loads to 40,000 pounds.

As the live cattle market moved away from live weight pricing systems, continued reliance on live weight pricing by the futures market further hampered basis convergence. Of approximately 200,000 lots of cattle purchased by packers between April 1992 and April 1993, only 45% were purchased on a live weight basis (Grain Inspection, Packers and Stockyards Administration, pg. 17). To account for this trend, a carcass grading system was implemented with the June 1995 contract. Under this system, the long can opt to take delivery under the older certificate system or require that the animal be delivered to an approved slaughter facility and graded on carcass value. Since its introduction, nearly 75% of deliveries have been carcass graded (Murphy). A second important provision of the new system adjusts par delivery grades from 100% choice to 55% choice.

One major limitation of the carcass-based delivery contract is that premiums and discounts are specified by the contract. Since data on premiums and discounts were not available until recently, the exchange set discounts artificially high. This decision deters delivery of sub-par cattle (Murphy). However, it increases delivery risk of shorts.

Past Studies of Basis Convergence in Cattle Markets

Elam (1988) used Arkansas prices to determine hedging risks for feeder cattle under delivery and cash settlement. The study used data from before the initiation of cash

settlement, thus actual basis data was used for the delivery case only. The Cattle-Fax price index was used to approximate the futures price level for the same time period if the contract were under cash settlement. A comparison of hedging risk under both methods indicated that risk was reduced for heavier cattle and lighter calves during the fall. However, lighter calves exhibited more hedging risk during spring markets. Schroeder and Mintert used a similar methodology to study prices at Amarillo, Dodge City, Kansas City, and Illinois Direct markets. They found reduced hedging risks in nearly all markets, weights, and contract months. Kenyon, Bainbridge, and Ernst compared basis performance for Oklahoma City and Virginia markets before and after the move to cash settlement. They noted an insignificantly smaller standard deviation for the basis after the change but no reduction in basis risk for Virginia producers. They concluded that no change in basis risk for hedgers and increased correlation between cash and futures results in “an improvement for both hedgers and the CME.” Similarly, Rich and Leuthold found weak evidence to support a hypothesis of basis risk reduction in their study of various feeder cattle markets. However, they warned that this improvement may diminish over time, especially for markets geographically separated from the central U.S.

Related studies have also been conducted for the live cattle markets. Purcell and Hudson compared basis performance before and after the move to certificate delivery. They found no consistent evidence to suggest a smaller basis variance after this change. Elam (1992) considered forward contracting and hedging in the fed cattle market. He determined that cash contracting reduces returns by 28 to 59 cents per cwt. for steers and 86 to 164 cents per cwt. for heifers, based on a sample of Texas feedlots. It was

suggested that feeders may use contracts despite the lower prices to eliminate basis risk and margin requirements, as well as provide a guaranteed cash buyer. Murphy provided an early look at basis performance under the carcass-graded contract. His results indicated a reduction in the variance of the mean basis for each tender period. However, the daily basis variance had increased on average.

Impacts of Changes on Basis Convergence

In this study, the impacts of contract modifications are reviewed using a common methodology. This differs from past studies that used different methodologies, making inferences across results more difficult. Specific attention is paid to cash-futures correlation and to impacts on basis variation, measured through its standard deviation.

Contracts for five years before and after the specification change were selected for study. Study period dates, shown in the footnotes to Table 1, represent dates when the selected contracts are used to determine nearby basis. A shorter history is used for the fourth period of each commodity due to insufficient data. Daily closing futures price, cash price, and basis summary statistics are shown in Table 1. The price data are obtained from Tick Data Inc. of Denver, CO.¹

Other than a trend towards improved cash-futures correlation, little can be ascertained regarding the feeder cattle basis. Post-change periods are marked by

¹ It should be noted that the firm no longer supports cash data and discontinued the series at the beginning of 1997. Details as to how the cash price is calculated are no longer available for either series. However, these prices should provide a representative cash market index.

Table 1. Daily Futures, Cash, and Nearby Basis Statistics for each Study Period.

Period ¹	Feeder Cattle					Live Cattle				
	Ave.	Min.	Max.	Std. Dev.	Corr. ²	Ave.	Min.	Max.	Std. Dev.	Corr. ²
1										
Close ³	65.71	52.50	74.73	3.85		65.60	51.65	79.78	4.68	
Cash	66.16	58.00	74.50	3.30	0.80	65.03	52.00	77.70	4.62	0.91
Basis	0.45	-5.35	7.70	2.34	-0.52	-0.58	-6.23	5.43	1.95	-0.24
2										
Close	79.76	59.88	91.05	7.92*		64.09	50.98	75.43	5.07	
Cash	88.76	65.40	105.25	9.76*	0.97	63.47	49.75	79.00	5.69*	0.90
Basis	9.01	2.83	17.00	2.77*	0.57	-0.62	-9.25	13.28	2.52*	0.01
3										
Close	83.07	69.78	91.05	4.07		74.54	62.28	83.73	3.97	
Cash	92.39	78.90	105.25	5.22	0.86	73.45	59.25	87.50	5.16	0.87
Basis	9.32	1.23	17.00	2.71	0.15	-1.09	-7.68	6.15	2.57	0.21
4										
Close	73.29	48.08	89.35	10.51*		65.19	54.80	73.63	3.56	
Cash	79.69	54.25	102.50	13.58*	0.97	63.87	51.50	74.25	3.93*	0.75
Basis	6.40	-3.07	15.98	4.31*	0.61	-1.32	-8.45	7.73	2.70	-0.24

* Indicates a significant change ($\alpha=0.10$) in the standard deviation between the pre and post change environments. Recorded in periods 2 and 4 only.

¹ Period dates for feeder cattle are: 1) August 1981 to August 1986; 2) August 1986 to August 1991; 3) November 1987 to November 1992; and 4) November 1992 to November 1996. For live cattle, these dates are: 1) October 1978 to October 1983; 2) October 1983 to October 1988; 3) April 1990 to April 1995; and 4) April 1995 to December 1996.

² Correlation coefficient between cash or basis and the futures closing price.

³ From 1978 through 1981, the live cattle contract also included a January delivery. Nearby basis is calculated using the January price when applicable, but are included with the February delivery period.

Footnotes for Table 2.

* Indicates a significant change ($\alpha=0.10$) in the standard deviation between the pre and post change environments.

¹ Approximate number of observations per period: Jan.-Mar., 40; Apr.-May, Sep.-Nov., 20; Aug., 65.

² Provides summary statistics on mean basis level for observations in each period.

significantly increased price variation. However, since this increase occurs in both cash and futures markets, it is doubtful that the increase resulted from changes to the contract specifications. Feeder cattle also show an increased basis variance, but this is more likely associated with the increased price variance than a change in settlement procedure. The final period shows a sharp increase in basis variance. A plot of basis activity, however, shows a downward trend in the basis throughout this time period. Both modifications do result in a notable reduction in the ratio of basis deviation to cash price deviation.

By contrast, the live cattle market shows little change in price variation. Each of the post change periods shows some increase in cash price variation, but only the move to certificate delivery showed a significant impact on the basis. Basis variation is wider in the second period and wider yet, though not significantly, in the final period. In this market, both post-change periods have a larger basis to cash deviation ratio than its preceding period. Furthermore, cash-futures correlation has declined in each period.

Tables 2 and 3 provide a more detailed view of basis activity, the first table referring to feeder cattle and the second to live cattle. Each studied delivery period is included in one of these two tables. Two different aspects of basis activity are considered. Intra-delivery period variances are compared for periods before and after the change. In addition, average data from pre and post periods are considered for an inter-delivery view.

The increase in feeder cattle basis variation found in Table 1 is not as clearly represented in Table 2. From the intra-delivery perspective, comparing changes on a period by period basis, the initial move to cash settlement results in 6 cases where variance decreased and five cases where it increased. The 1993 refinement performed slightly

Table 2. Feeder Cattle Nearby Basis Variance for each Delivery in Each Study Period.

Month ¹	Period 1		Period 2		F Stat.	Period 3		Period 4		F Stat.
	Ave.	Std. Dev.	Ave.	Std. Dev.		Ave.	Std. Dev.	Ave.	Std. Dev.	
Jan. (ave) ²	-0.88	0.53	7.71	2.14	0.25*	8.15	1.69	5.48	2.72	0.62
1	-0.43	1.80	4.83	0.77	2.32*	7.52	2.74	5.13	1.52	1.80*
2	-0.86	1.25	7.52	2.74	0.46	8.89	2.21	8.04	1.32	1.68*
3	-1.81	1.91	8.89	2.21	0.86	6.27	1.20	7.60	1.40	0.86
4	-1.00	1.28	6.27	1.20	1.07	11.05	1.11	1.19	1.30	0.86
5	-0.30	1.09	11.05	1.11	0.98	7.01	1.33			
Mar. (ave)	0.74	0.87	9.34	1.88	0.46	10.16	0.84	8.76	3.46	0.24*
1	-0.09	1.05	5.98	0.96	1.09	9.66	2.04	9.60	0.67	3.06*
2	0.35	1.05	9.66	2.04	0.52*	9.75	1.75	11.46	1.82	0.96
3	-0.03	0.90	9.75	1.75	0.51*	9.52	1.55	11.10	1.16	1.34
4	1.38	1.96	9.52	1.55	1.27	11.80	0.91	2.89	1.04	0.88
5	2.12	1.56	11.80	0.91	1.71*	10.08	1.06			
Apr. (ave)	2.81	2.00	10.97	1.97	1.01	11.60	0.87	10.05	3.18	0.27
1	0.48	0.55	7.22	0.59	0.94	11.30	2.62	11.96	0.59	4.41*
2	2.86	1.70	11.30	2.62	0.65	11.75	1.53	12.73	0.90	1.70
3	0.71	0.65	11.75	1.53	0.43	11.53	0.81	10.86	1.55	0.53*
4	4.54	1.04	11.53	0.81	1.28	13.07	1.89	4.67	1.04	1.82*
5	5.47	1.15	13.07	1.89	0.61	10.36	1.26			
May (ave)	2.99	1.80	9.91	2.23	0.81	10.66	1.46	8.90	3.43	0.43
1	-0.28	0.67	6.52	0.84	0.81	9.14	1.04	10.75	0.97	1.08
2	3.61	1.09	9.14	1.04	1.04	9.14	1.07	12.13	2.80	0.38*
3	2.78	0.77	9.14	1.07	0.71	12.44	0.35	9.54	0.80	0.44*
4	3.69	1.85	12.44	0.35	5.29*	12.31	1.01	3.18	1.34	0.76
5	5.13	1.32	12.31	1.01	1.30	10.26	1.21			
Aug. (ave)	0.29	1.15	10.51	1.58	0.73	10.50	1.59	6.25	3.98	0.40
1	-0.22	2.24	8.92	1.26	1.77*	9.46	1.83	11.14	2.74	0.67*
2	1.64	1.63	9.46	1.83	0.89	9.50	1.49	8.54	1.83	0.81
3	-1.64	0.90	9.50	1.49	0.60*	11.53	1.59	4.73	2.13	0.75
4	0.49	1.52	11.53	1.59	0.95	13.12	2.83	0.60	1.81	1.56*
5	1.18	1.41	13.12	2.83	0.50*	8.88	2.89			
Sept. (ave)	0.33	2.20	7.52	1.54	1.43	7.91	1.08	4.20	2.99	0.36
1	-2.93	1.09	4.92	0.52	2.09*	7.15	0.99	7.92	1.11	0.89
2	-1.02	1.04	8.77	0.87	1.19	7.42	1.17	6.33	1.12	1.04
3	3.15	0.69	7.15	0.99	0.69	9.34	1.88	1.68	1.71	1.10
4	0.16	0.76	7.42	1.17	0.65	9.02	1.03	0.87	0.88	1.18
5	2.27	1.46	9.34	1.88	0.78	6.61	0.90			
Oct. (ave)	-0.58	1.39	6.67	0.72	1.92	6.41	1.38	2.68	3.37	0.41
1	-1.54	0.90	5.28	0.70	1.27	7.23	1.09	6.68	1.09	1.00
2	-1.81	1.50	7.13	1.12	1.35	6.62	0.65	5.25	1.22	0.53*
3	2.03	0.81	7.23	1.09	0.74	7.07	2.01	-1.42	0.78	2.56*
4	-1.23	1.08	6.62	0.65	1.67	7.43	1.24	0.21	1.14	1.09
5	-0.32	1.11	7.07	2.01	0.55*	3.71	2.23			
Nov. (ave)	-0.45	2.16	7.26	1.35	1.59	6.77	0.85	2.68	3.31	0.26
1	-2.12	1.13	4.87	0.61	1.85*	7.31	0.96	5.60	1.08	0.89
2	-2.60	1.36	9.07	1.41	0.96	7.52	0.96	5.74	0.41	2.35*
3	2.95	0.87	7.31	0.96	0.91	7.56	1.53	-2.32	0.47	3.30*
4	-1.71	1.00	7.51	0.96	1.04	5.79	1.18	1.70	1.85	0.64
5	1.22	1.62	7.55	1.53	1.06	5.68	1.05			

See footnotes below Table 1.

Table 3. Live Cattle Nearby Basis Variance for each Delivery in Each Study Period.

Month ¹	Period 1		Period 2		F Stat.	Period 3		Period 4		F Stat.
	Ave.	Std. Dev.	Ave.	Std. Dev.		Ave.	Std. Dev.	Ave.	Std. Dev.	
Feb. (ave) ^{2,3}	-0.70	0.75	-0.51	0.70	1.07	-1.64	1.91			
1	-1.84	0.84	-1.19	1.01	0.83	1.50	1.94	1.54	0.91	2.12*
2	-0.23	1.27	-0.71	0.70	1.82*	-3.07	1.23			
3	-1.05	0.84	0.66	1.53	0.55*	-0.52	1.50			
4	0.37	1.60	-0.16	1.99	0.81	-2.31	0.85			
5	-0.75	1.06	-1.19	2.84	0.37*	-3.80	1.28			
Apr. (ave)	-1.75	0.63	-2.30	0.94	0.67	-1.25	1.13			
1	-2.15	1.12	-2.01	0.82	1.36	-0.48	0.88	-1.50	1.35	0.66*
2	-1.00	1.48	-3.43	0.86	1.73*	-1.04	1.03			
3	-1.89	1.28	-2.47	1.47	0.87	0.13	1.86			
4	-1.08	0.95	-2.93	1.00	0.95	-3.16	0.86			
5	-2.63	1.03	-0.67	2.25	0.46*	-1.70	1.61			
Jun. (ave)	-0.20	1.16	0.66	2.82	0.41	2.24	0.89	-0.56		
1	-0.41	1.43	0.47	0.90	1.59*	3.10	1.98	1.27	1.64	1.21
2	-1.07	0.96	-3.86	1.85	0.52*	2.09	1.47	-2.40	2.21	0.66
3	-1.75	1.21	-0.52	1.40	0.87	2.55	1.00			
4	1.07	0.90	3.16	1.38	0.65*	2.84	2.11			
5	1.18	1.21	4.06	0.93	1.29	0.60	1.59			
Aug. (ave)	0.85	0.94	1.00	1.75	0.54	-1.21	1.35	-2.25		
1	0.46	1.67	1.54	0.89	1.88*	-0.15	1.32	-0.77	1.12	1.18
2	-0.49	0.80	-2.03	0.99	0.80	-0.73	1.34	-3.73	1.45	0.92
3	1.44	1.76	0.88	1.21	1.46	-0.22	1.26			
4	2.28	2.30	3.41	2.48	0.93	-1.14	1.05			
5	0.58	1.57	1.21	3.48	0.45*	-3.80	1.40			
Oct. (ave)	0.17	0.78	-0.46	2.13	0.37	-2.97	1.32	-3.29		
1	-0.59	1.83	0.24	1.15	1.59*	-1.54	0.63	-3.10	0.92	0.69
2	0.92	1.64	-3.84	1.06	1.55*	-4.61	1.34	-3.49	1.48	0.91
3	-0.96	1.08	1.27	0.97	1.12	-1.82	0.68			
4	0.62	2.02	1.94	1.16	1.74*	-2.37	1.23			
5	0.85	2.02	-1.90	1.00	2.02*	-4.50	1.61			
Dec. (ave)	-1.88	0.68	-0.91	1.56	0.43	-1.73	2.07	1.16		
1	-1.33	1.53	-2.02	1.24	1.24	1.64	0.80	-1.73	1.45	0.55*
2	-2.08	2.08	-1.40	0.60	3.45*	-4.13	1.77	4.05	2.20	0.80
3	-2.32	1.18	-2.94	1.26	0.94	-0.43	0.92			
4	-2.77	1.86	1.10	0.84	2.21*	-2.87	1.40			
5	-0.90	1.14	0.69	0.97	1.19	-2.87	1.19			

* Indicates a significant change ($\alpha=0.10$) in the standard deviation between the pre and post change environments.

¹ There are approximately 40 observations in each period.

² Provides summary statistics on mean basis level for observations in each period.

³ See footnote 3, in Table 1.

better with 9 variance reductions and 5 increases. Inter-period comparisons reveal one case of increased variation in the post change period following contract re-specification.

The general trends of these results change little when we consider live cattle in Table 3. The intra-delivery comparisons for the certificate delivery system show 10 cases where variance decreased versus 6 cases where it increased. The limited data available for the carcass-graded system show one reduction and two increases. Inter-delivery comparisons are only available for the first contract revision, but show no significant impacts on basis variation.

Conclusions

Based on these results, revisions to these cattle contracts have made marginal impacts on basis performance. The feeder cattle contract shows some improvement, mainly through improved cash-futures correlation. However, it appears that the live cattle performance may have been worsened by its changes. Results show little impact on intra-delivery or inter-delivery basis variance for live cattle. Furthermore, cash-futures correlation has decreased over time. Results for both commodities are generally consistent with the past studies cited. However, changes in basis variance and price correlation could be time-related. Specifically, the role of market structural change on the basis is not considered. Thus, one cannot necessarily imply that correlation or deviation changes are attributable to the changes in delivery mechanisms.

The debate over a satisfactory settlement procedure for live cattle continues. Cattle feeders are expressing concerns over the new grading system that exposes them to

carcass grading risk and exaggerated discounts. In response, a proposal to tie these premiums and discounts to the USDA report *National Carcass Premiums and Discounts for Slaughter Steers and Heifers* is under review. In addition, a recent position paper by Continental Grain is promoting cash settlement provisions for live cattle.

The idea of cash settlement in this market is not new. Kahl, Hudson and Ward studied this possibility in 1989. They concluded that cash settlement could improve basis performance if an acceptable cash index could be found. Several indices were considered in their analysis with an index by Cattle-Fax selected ahead of the others. However, the concentrated nature of this market, combined with alternative marketing methods used in cash marketing make construction of an index more difficult in this market (Murphy and Peterson). Current price reporting methods, lack of active terminal and auction markets, and high buyer concentration, especially within certain geographic locations, could result in price index manipulation (Kahl, Hudson and Ward).

The results provided here indicate considerable reason for concern over basis convergence. With live cattle basis variation in the third period ranging from \$2.50 to nearly \$6 per cwt., the market is exhibiting some substantial basis risk. Intra-period standard deviations near 1.5 translates to a \$6/cwt range in the basis during just one delivery period. Hedging benefits are severely hampered by this wide variation in the basis. However the feeder cattle results offer little definitive evidence that cash settlement would improve this performance. This is especially true in light of the potential difficulties with index development in the live cattle market. Before a credible solution to the convergence problem can be found, a solid understanding of its cause is needed.

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