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DELIVERIES ON THE CME LIVE CATTLE CONTRACT: AN ECONOMIC ASSESSMENT

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Background

The live cattle futures contract was introduced by the Chicago Mercantile Exchange (CME) in the mid-1960s. Despite skepticism regarding the economic viability of the contract, the contract succeeded and put the CME on the path to becoming one of the leading commodity exchanges in the world. Nonetheless, much of the criticism of futures markets in recent years has been directed at the live cattle contract.[1]

Specific criticisms have been directed at the usefulness of the live cattle contract as a risk transfer mechanism for producers and/or packers. Producer groups have expressed concern that the cash-futures basis is too variable to provide effective short hedging opportunities. Packers, on the other hand, have expressed continued concern over problems associated with delivery specifications and locations which limit long hedging effectiveness. These combined concerns may in part be responsible for the recent decline in trading volume from over 7 million contracts in 1979 to less than half that number in 1984 (see Purcell and Hudson, 1985, p. 322).

The criticisms from packers and producers have resulted in some experimentation in specifying delivery terms for livestock futures contracts. In fact, "the CME has been willing to modify delivery terms rather promptly to improve contracts" (Leuthold and Tomek, p. 40). For example, two modifications in the early the 1980s have attempted to address delivery related problems expressed by long hedgers. The tightening of contract specifications implemented in August 1981 and the move to a certificate delivery system implemented in December 1983 were both aimed at making the contract a more useful hedging mechanism.

Despite the importance of the delivery process, few research efforts have explicitly addressed the performance of livestock futures markets from the delivery perspective. Notable exceptions are the work of Crow, Riley, and Purcell regarding nonpar delivery points and the work of Powers regarding the effects of contract provisions on the success of futures markets. The purposes of this manuscript are to: (1) examine the economic factors affecting deliveries on the CME live cattle contract; (2) assess the impact of recent contract modifications on the delivery process; and (3) to consider potential differences in the delivery process resulting from the shift in cattle feeding from the midwest to the southwest.

The manuscript is structured as follows. The conceptual dimensions of delivery on livestock futures contracts are summarized in the next section. Section three presents a discussion of the economic factors affecting live cattle deliveries. Results of the empirical investigation are documented in section four. Conclusions are presented in section five. The manuscript concludes with a brief discussion of the implications of the study.

Conceptual Dimensions of Delivery

Before examining the factors which affect deliveries against maturing live cattle futures contracts it will be useful to briefly review the conceptual dimensions of delivery. Hieronymus argued that "one of the most difficult tasks in starting and operating a futures market is establishing the terms for delivery" (p. 340). This difficulty arises because the objective in writing a futures contract is to obtain a balance such that enough deliveries occur to test price, yet such that there is no widespread incentive to make or take delivery. In other words, the contract should

have delivery provisions which are in balance, favoring neither the longs or shorts.

In agricultural futures markets, delivery is rarely made or taken as futures contracts are entered into for reasons other than exchange of title (Hieronymus, p. 340). Recall that a futures contract represents a temporary substitute for a subsequent cash market position. Because of this relationship, the incentive to deliver derives primarily from the relationship between cash and futures prices during the delivery month, i.e., the cash-futures basis. Conceptually, as the absolute value of the basis increases deliveries would be expected to increase at an increasing rate (Purcell and Hudson, 1986). In other words, when the futures price moves above the cash price by an amount greater than the costs of delivery it will become more profitable to deliver against the contract.[2]

Purcell and Hudson (1986) argue that the forces of delivery will then work to narrow the basis as: (1) delivering shorts do not buy back their futures positions, thereby removing buying pressure from the market and allowing futures to drift lower, (2) arbitrage traders sell futures to establish short positions and buy cash cattle to deliver against these positions, thereby pressuring futures downward and boosting the cash market, and (3) speculators holding long positions and not wanting to take delivery close out their positions, pushing futures lower. It should be clear from this discussion that involvement in the delivery process will depend in large part on the magnitude of the basis relative to the market participants costs of delivery and willingness to accept the risk inherent in the delivery process, including location, quality considerations, and resale opportunities in the delivery market (if the cattle are not wanted).

Finally, it should be noted that "imperfections in the cash markets may make delivery on futures a reasonable alternative for some firms" (Paul, p. 8). The cash market imperfections to which Paul refers might also be imperfections in futures contract design. For example, "the changing nature of the cattle industry, particularly due to changes in consumer demand may result in changes in the commercial product base. As a result contract terms may get out of line with shifts in the underlying structure of production and trade" (Paul, p. 12). If the futures contract fails to reflect changes in production and trade, or reflects them inadequately via an incorrect premium and discount structure, deliveries may increase as it becomes more economical to deliver in the futures market than in the cash market.

Factors Affecting Live Cattle Deliveries

Deliveries on livestock futures contracts tend to average less than two percent of open interest at the beginning of the delivery month.[3] A summary of annual live cattle deliveries by delivery points from 1975 through 1984 is presented in Table 1. Note that the largest number of deliveries occur in Sioux City, while the other points appear to generally move together across the data period. The annual data, however, mask much of the variability in deliveries at each location across contract months. A more detailed examination of the factors which affect deliveries will provide additional insight into the delivery process and the sources of possible aberrations in the process.

TABLE 1. SUMMARY OF ANNUAL DELIVERIES ON THE CME LIVE CATTLE CONTRACT BY DELIVERY POINTS, 1975-84.

	Delivery Points[a]					
Year	Omaha	Sioux City	Peoria	Joliet	Guymon	Greeley
1975	148	524	207	74	65	-
1976	469	968	917	856	0	-
1977	170	241	293	328	0	-
1978	217	1688	559	217	574	-
1979	447	3314	861	266	1418	-
1980	530	2247	244	126	291	-
1981	574	3094	735	796	225	803
1982	30	647	277	352	75	129
1983	129	1122	512	915	223	32
1984	33	460	36	274	728	856

Source: CME Yearbook, various issues.

[a] The Greeley, Colorado delivery point was added in August 1981. In June 1985 Guymon, Oklahoma was dropped and Amarillo, Texas and Dodge City, Kansas were added.

The above conceptual framework suggests that live cattle deliveries will respond primarily to changes in the cash-futures basis. However, when we consider the nature of cattle feeding and the delivery provisions of the contract, other factors which will affect deliveries can be hypothesized.

Cattle are typically fed for a period of 90 to 150 days. The cattle feeder with a short position in the futures market therefore often has some flexibility in marketing the fed animals as the delivery month approaches. Specifically, if price expectations, as registered by the futures market, reflect an increase in live cattle prices during the coming month, the feeder may choose to feed the cattle to heavier weights in the hope of receiving a higher price. It is, therefore, hypothesized that deliveries will respond to the spread between the expiring futures contract price and the next nearby contract price. As the spread widens, i.e., the next nearby contract increases in price relative to the expiring contract, deliveries should decrease.

The mechanics of the delivery process may also influence the number of deliveries. Three such dimensions have received attention in recent years: (1) deliverable grades of cattle, (2) the physical process of delivery, and (3) delivery locations.

The live cattle contract has suffered from overdelivery of heavy yield grade 4 (Y4) animals in recent years. These animals have been included in futures deliveries because their value in cash outlets is less than their value in futures due to the discount structure employed in futures. The overdelivery problem prompted the CME to tighten contract specifications, effective in August 1981, to reduce the number of Y4 cattle which could be included in a delivery load without penalty. Prior to the specification

change up to 8 head of estimated yield grade 4 steers could be included in a delivery load without penalty. The current futures contract allows only four Y4 animals without penalty and assesses a discount of 15 percent of the settlement price to additional Y4s. A maximum of 8 yield grade 4 animals are allowed in a delivery load. Thus when cash market discounts for Y4 animals increase above the futures discount (averaged across the number of Y4s in the load), it becomes more profitable to deliver the cattle in the futures market than to sell them in the cash market.

Based on this discussion, it is hypothesized that deliveries will respond to changes in the cash market discount for Y4 carcasses. As the discount increases, i.e., Y3 carcass prices increase relative to Y4 carcass prices, deliveries will increase. Further, if the specification change was successful, the response of deliveries to changes in the Y4 discount should be smaller after the change was implemented.

The physical process of delivery has also been subjected to criticism in recent years. Specifically, concern began to emerge in the late 1970s regarding the redelivery of cattle and the lack of a means for the long hedger to specify delivery locations. It was argued that the long hedger needed to be able to specify where cattle would be received in order to be willing to participate in the delivery process. Moreover, the redelivery of cattle, in addition to distorting perceptions of the supply of deliverable cattle, brings about the possibility of bruise damage, tissue shrink, and poor yields, making the cattle an undesirable product.

The redelivery concern and the inability of the packer to enter the delivery process and specify the desired location for receipt of cattle were addressed by the certificate delivery system implemented in December 1983.

The certificate system essentially serves to improve communication and coordination within the delivery process by allowing the long to issue a "demand notice" specifying the market where cattle will be received.[4] Since the certificate system essentially eliminates the redelivery of cattle, it is hypothesized that mean number of deliveries under the certificate system will be lower than under the physical delivery system.

Delivery locations for live cattle have also been a source of concern in recent years. As the cattle feeding industry has moved to the southwest, concern has been expressed that the delivery points east of the Mississippi have become less representative of the industry and therefore may be subject to aberrations in the delivery process. It is hypothesized that deliveries in the points east of the Mississippi respond to the same economic factors as deliveries in points west of the Mississippi. Further, if the preceding hypothesis is supported, the impacts of the specification change and the certificate delivery system should be similar in these markets.

Empirical Results

Deliveries were modeled for the period from January 1975 through April 1985. Data on total monthly deliveries against all futures contracts maturing during the period for each of the live cattle delivery points, average cash prices for all delivery points during the first week of the delivery month, and average futures prices during the first week of the delivery month were obtained from CME research staff. Average prices for yield grade 3 and yield grade 4 carcasses during the first week of the delivery month were transcribed from the National Provisioner.[5]

The following variables were created for the analysis:

Deliveries - three delivery variables were created for each contract reflecting: (1) total deliveries in all points, (2) deliveries in points east of the Mississippi River, and (3) deliveries in points west of the Mississippi River.

Delivery Month Basis - the cash minus futures basis was computed using the weekly average cash price in each delivery point and the weekly average futures price during the first week of the delivery month.

Futures Spread - the spread between the expiring futures contract and the next nearby contract was computed by subtracting the weekly average price for the next nearby contract from the weekly average price for the expiring futures contract during the first week of the delivery month.

Y4 Discount - the discount between yield grade 4 and yield grade 3, 600-700 pound steer carcasses was computed by subtracting the weekly average price for yield grade 3 carcasses from the weekly average price for yield grade 4 carcasses during the first week of the delivery month.

Specification Change - the product of Y4 Discount and an intercept dummy variable which is equal to zero for contracts maturing prior to the August 1981 contract and equal to one for the August 1981 contract and all subsequent contracts.

Certificate Delivery - an intercept dummy variable which is equal to zero for contracts maturing prior to the December 1983 contract and equal to one for the December 1983 contract and all subsequent contracts.

Contract - a set of intercept dummy variables for each contract month except February.

Models were estimated for each of the three delivery variables using ordinary least squares methods. All models were diagnostically checked for collinearity with no problems being detected (see Belsley, Kuh, and Welsch). Durbin-Watson statistics were examined for each of the models with two being in the inconclusive range and the other showing no serial correlation problems. An autoregressive correction procedure was applied to the models with inconclusive Durbin-Watson results. No significant differences were found in these models and the estimated autoregressive parameter was insignificant at the .05 level in both cases. Based on these results it was concluded that serial correlation was not a problem and therefore only the OLS results are reported below.

The equations were specified with Deliveries as the dependent variable and all other variables on the right hand side. For the total deliveries model and the model for deliveries west of the Mississippi River the Omaha basis was used. The model for deliveries east of the Mississippi River used the Joliet basis. The results of the estimations are summarized in Tables 2, 3, and 4.

Table 2 presents the parameter estimates, along with their standard errors and p-values, from the model for total deliveries. The model explains slightly more than 54 percent of the variability in Deliveries during the period. As hypothesized, the Delivery Month Basis (Omaha) is significant and negative, supporting the hypothesis that deliveries will decline as the delivery month basis tightens. The spread between the expiring and the next nearby contract is not statistically significant.

The estimated parameters for Y4 Discount and Specification Change are both significant (p-values of .0001 and .0023, respectively) and carry the

TABLE 2. ESTIMATED MODEL FOR DELIVERIES AGAINST LIVE CATTLE FUTURES CONTRACTS MATURING BETWEEN JANUARY 1975 AND MAY 1985, ALL DELIVERY POINTS.

Variables	Parameter Estimates	Standard Errors	Prob > t
Intercept	-97.257	125.553	0.4421
Omaha Basis	-180.336	34.908	0.0001
Futures Spread	-24.674	23.726	0.3032
Y4 Discount	-70.128	16.139	0.0001
Specification Change	44.406	13.984	0.0023
Certificate Delivery	-79.674	145.650	0.5867
April Contract	221.417	145.824	0.1350
June Contract	238.379	155.032	0.1302
August Contract	267.269	158.084	0.0969
October Contract	165.972	146.864	0.2636
December Contract	59.710	153.920	0.6997

R-Square	0.6163	F Value	8.353
Adj. R-Square	0.5425	Prob > F	0.0001
Durbin-Watson	1.803	N = 63	

expected signs. The Y4 Discount is negative, reflecting the fact that as the discount between yield grade 3 carcasses and yield grade 4 carcasses narrows deliveries will decline. Specification Change, a slope shifter designed to determine whether the tightening of delivery specifications to reduce the number of Y4 animals which could be delivered without penalty was successful, suggests that the response of deliveries to changes in the Y4 Discount is in fact smaller following the specification change.

The Certificate Delivery variable is not statistically significant, suggesting that there has been no significant reduction in the mean number of deliveries since the certificate system was initiated. However, it should be noted that only nine contracts maturing under the certificate system were included in the analysis. Moreover, the parameter estimate is a large negative number suggesting that a significant reduction in deliveries might result from a longer history with this new delivery system.

The Contract variables are all positive, suggesting that the fewest deliveries occur against the February contract. Note that none of the contract variables are significantly different from zero at the .05 level, however, suggesting seasonal influences on total deliveries are small.

Table 3 summarizes the results of the model for deliveries east of the Mississippi River. The model explains over 45 percent of the variability in deliveries. The Delivery Month Basis (Joliet) and the Futures Spread are significant and of expected signs.

The Y4 Discount and Specification Change variables, however, are not significant, suggesting deliveries east of the Mississippi do not respond to Y4 discounts and have not responded to the specification change in the same manner as total deliveries. The Certificate Delivery variable is

TABLE 3. ESTIMATED MODEL FOR DELIVERIES AGAINST LIVE CATTLE FUTURES CONTRACTS MATURING BETWEEN JANUARY 1975 AND MAY 1985, DELIVERY POINTS EAST OF THE MISSISSIPPI RIVER.

Variables	Parameter Estimates	Standard Errors	Prob > t
Intercept	-0.246	54.902	0.9964
Joliet Basis	-66.746	14.786	0.0001
Futures Spread	-26.893	10.113	0.0104
Y4 Discount	4.584	7.082	0.5202
Specification Change	3.517	6.349	0.5820
Certificate Delivery	-110.285	63.605	0.0889
April Contract	88.109	69.027	0.2075
June Contract	243.954	69.244	0.0009
August Contract	134.884	67.554	0.0511
October Contract	16.966	63.960	0.7919
December Contract	12.133	69.721	0.8625

R-Square	0.5429	F Value	6.175
Adj. R-Square	0.4549	Prob > F	0.0001
Durbin-Watson	2.180	N = 63	

significant at the .01 level, suggesting the certificate delivery system has significantly reduced deliveries in these points.

The Contract variables are all positive in sign, supporting the notion that deliveries in the points east of the Mississippi are smaller in February than in other contract months. Deliveries against the June and August contracts are significantly larger than in February, suggesting that seasonality is important in the eastern markets.

The results of the model estimated for deliveries west of the Mississippi are presented in Table 4. The model explains over 44 percent of the variability in deliveries and is similar to the model for total deliveries.

In short, deliveries in points west of the Mississippi respond to the Delivery Month Basis and Y4 Discounts. As expected, the response of deliveries in these points to changes in the 44 discount is smaller following the specification change. The Certificate Delivery system, however, appears to have had no significant effect on the mean number of deliveries in the western delivery points.

Conclusions

The results in the preceding section provide several insights into the factors which affect deliveries on the CME live cattle contract. These issues can be summarized in terms of the economic factors affecting deliveries, the impact of contract modifications, and differences between markets east and west of the Mississippi.

When aggregated across all delivery points, live cattle deliveries respond to changes in the delivery month basis, changes in the discount between yield grade 3 and yield grade 4 carcasses, and, to a limited extent,

TABLE 4. ESTIMATED MODEL FOR DELIVERIES AGAINST LIVE CATTLE FUTURES CONTRACTS MATURING BETWEEN JANUARY 1975 AND MAY 1985, DELIVERY POINTS WEST OF THE MISSISSIPPI RIVER.

Variables	Parameter Estimates	Standard Errors	Prob > t
Intercept	-76.092	112.442	0.5016
Omaha Basis	-112.661	31.262	0.0007
Futures Spread	-3.780	21.249	0.8595
Y4 Discount	-68.209	14.454	0.0001
Specification Change	44.939	12.524	0.0007
Certificate Delivery	47.598	130.440	0.7167
April Contract	66.515	130.596	0.6127
June Contract	-69.938	138.842	0.6166
August Contract	70.177	141.575	0.6222
October Contract	108.490	131.527	0.4132
December Contract	-2.662	137.847	0.9847

R-Square	0.5326	F Value	5.924
Adj. R-Square	0.4427	Prob > F	0.0001
Durbin-Watson	1.9738	N = 63	

seasonal influences. The spread between the maturing future and the next nearby contract does not appear to be an important factor in the delivery process.

Recent contract modifications have yielded mixed results. The certificate delivery system has not had a significant impact on total deliveries during its short history. The specification change, aimed at reducing the incentive to deliver Y4 animals, however, appears to have had the desired impact as the response of deliveries to changes in the Y4 discount is lower following the specification change.

The markets east of the Mississippi do not appear to respond to the same economic factors as markets west of the Mississippi. Deliveries in the eastern markets respond to changes in the delivery month basis, the spread between the maturing and the next nearby futures contract, and strong seasonal influences. Responses to the discount between Y3 and Y4 carcasses are not present in the eastern markets and, therefore, the specification change has not had a significant impact in these markets. The eastern markets, however, have responded to the certificate delivery system.

The differences between the responses of deliveries to economic factors by the markets east and west of the Mississippi can be at least partially explained by considering the production and market structures in each area. The western markets are characterized by large commercial feedlots, whereas the eastern markets tend to have more seasonal producers. Thus seasonal differences in deliveries would be expected to be more significant in the east than in the west. Additionally, the large commercial, often custom, feedlots in the west are more dependent upon throughput. That is, cattle tend to be moved into slaughter channels when they are ready as the space is

needed for new feeder cattle. In the less commercial eastern markets, feeders may be more likely to hold cattle when expectations of higher prices are seen. This may in part explain the differential response to the spread between the maturing and the next nearby future in the two markets.

There are also significant differences in packer demand between the two market areas. The eastern markets are characterized by few buyers, whereas the western markets have a much higher buyer concentration. The lack of response to the Y4 discount by feeders in the east may be due to a lack of willingness on the part of the packer longs to stand in for delivery. As the spread between Y3 and Y4 cattle increases, indicating an excessive number of Y4s in the country, this problem may become particularly apparent. Alternatively, the lack of response to Y4 discount and to the specification change may reflect a difference in the quality of cattle produced in the two areas which is reflected in their respective delivery patterns. This latter reason may in part explain the response of the eastern markets to the certificate delivery system, as the demand notice allows the long to specify the delivery location. That is, if the eastern cattle are a less desirable product, then longs would issue demand notices for other markets, thereby reducing deliveries in the eastern markets.

Finally, the differential responses between the eastern and western markets may simply indicate differences in the level and sophistication of futures market use by producers and packers in the two areas. The commercial cattle feeders of the west may have learned how to effectively utilize the delivery option to their advantage. For example, it appears the western producers use futures deliveries to merchandise Y4 cattle at a premium when cash market discounts are high. Similarly, the packers in this

area may be more willing to stand for delivery due to a more consistent quality of cattle and/or a more convenient location in the western markets.

Implications

The results presented herein suggest that live cattle deliveries are, in the aggregate, responding to appropriate economic phenomena. The delivery points east of the Mississippi, however, do not appear to respond in the same manner as the markets west of the Mississippi. Continued dialogue should focus on the reasons for the differential responses in the two market areas. Important questions which should be addressed include: What economic forces are at work which create the observed differences between the eastern and western delivery points? Do these differences have detrimental impacts of the delivery process and thereby adversely affect the live cattle contract? Have the recent contract modifications adequately addressed these differences?

Finally, further research is needed to clarify other factors which affect deliveries. The models presented herein explain approximately 50 percent of the variability in deliveries during the time period studied, suggesting there are other important factors to which deliveries respond. Futures research efforts should consider such factors as: (1) measures of product supply and demand at each delivery point, (2) the impact of industry structure on deliveries, i.e., are there tax, accounting, or business practices used in cattle feeding which make delivery desirable, and if so under what conditions, and (3) identification of the principals involved in the delivery process, i.e., who makes and takes delivery and why?

FOOTNOTES

[1] See Purcell and Hudson, (1985, pp. 334-336) for a summary of these criticisms.

[2] For simplicity the case where the futures price is below the cash price during the delivery month is not considered.

[3] Annual live cattle deliveries as a percentage of annual open interest at the beginning of the delivery month between 1975 and 1983 ranged from a low of .39 percent in 1977 to a high of 2.08 percent in 1981. Similarly, live hog deliveries ranged between .16 and 1.31 percent of annual open interest during the same period.

[4] The specifics of the certificate system, along with a preliminary evaluation are discussed in Purcell and Hudson (1986).

[5] Average prices during the first week of the delivery month were used for consistency with the individual delivery point data being used in the analysis. While daily or weekly data throughout the delivery month would be preferable, such data are not available to allow a breakdown of deliveries by delivery points during each month. The data availability and scope of the research therefore dictated the use of weekly data. To verify the models estimated below, a data set for total deliveries was generated on a weekly basis and the total deliveries model re-estimated. The results were similar to those reported below and thus lend support to the models presented in this section.

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