Implications of Trader Mix to Price Discovery and Market Effectiveness in Live Cattle Futures

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Introduction

Futures markets have been widely researched in terms of their pricing efficiency. Much of the research literature employs the framework originally offered by Fama (1970), a conceptualization built on the notion that an "efficient" market will discover a price that reflects the impact of available information on supply and demand. Rowsell (1992) included some 19 technical articles on livestock futures alone in his review of the literature on marketing efficiency. The research tends to be organized around two broad analytical approaches.

One approach is to attempt the conceptualization of a model that will earn significant profits if the model is employed in guiding trades for particular commodities. There is some debate over whether and how trading costs (commissions, interest on margins) should be accounted for, but markets are generally judged to be inefficient if the models prove to be profitable over time. If the models use publicly and/or privately held information and earn profits, then there is evidence that not all information is being incorporated into the price discovery process. A number of published research efforts use this approach (Peterson and Leuthold, 1982; Tomek and Guerin, 1984; Pluhar et al., 1985; Garcia, et al., 1988; Leuthold et al., 1988).

An alternative methodology focuses attention on the short-term (usually day-to-day) price movements in the markets. If all available information is being incorporated, then the information "shocks" that periodically hit the market should follow a random process and the changes in price from day t to day t + I should be uncorrelated. There is dialogue over what type of random process (Martingale, random walk, etc.) the price changes follows, but the basic approach remains the same. If there are more than a threshold number of non-random price changes in the market, then there is statistical evidence of market inefficiency. There are also a number of examples of this type of research (Danthine, 1977; Leuthold and Hartmann, 1979; Ward, 1980; Taylor, 1985; Coiling and Irwin, 1989).

This broad body of research is important. If the futures market for a particular commodity is found to be inefficient, then corrective actions and/or policy changes are needed. The futures exchanges might take actions to improve liquidity if low levels of volume of trade or small open interest might be a possible causal factor for the observed inefficiencies. If access to important information is a possible causal factor, then the exchanges and public agencies, i.e., Commodity Futures Trading Commission (CFTC), Market News in the United States Department of Agriculture (USDA), etc., might take actions to improve access to information and increase its quality (more frequent reports, better statistical samples, etc).

Research on marketing efficiency has, historically, led to changes and adjustments to improve the overall effectiveness of the markets in their assigned functions of contributing to price discovery and offering a mechanism for transfer of price risk. In the cattle futures, the move to a certificate delivery system in the early 1980s was prompted in part by the dearth of long hedges and the conceptual and empirical evidence that balance between hedgers and speculators is important for pricing efficiency. The live cattle contract goes to an optional carcass delivery system effective with the June 1995 contract. This move was also prompted by concerns over participation by long hedgers and past research efforts that show the market does not always incorporate all available information. The marketing efficiency literature has therefore been both a catalyst for change and a guide to that change.

AN ADDED DIMENSION

Much of the work on marketing efficiency has been unable to incorporate possible impacts of the type of trader mix on market efficiency. In particular, little is known about which traders "turn" the market when it has departed significantly from some underlying but unobservable equilibrium. Figure I presents a conceptual framework of the importance of traders in discovering an equilibrium price that balances the forces of supply and demand. Across a multi-day period in which daily futures closing prices decline significantly from the underlying equilibrium price, P, such as the prices in time segment CD, the necessary conditions for an inefficient market may or may not be present. If an analytical model is being applied in search of trading profits, it will not necessarily be able to predict, from point C in time, that prices will continue to decline relative to the underlying equilibrium price to point D. Even if direction of price movement from C to D is accurately forecasted, the market will usually move from point C to point D in a volatile fashion. The timing of buy/sell decisions may be such that no significant profits are earned in the downward trending market. Further, there may be no sustained sequence of statistically significant correlated day-to-day price changes because of the volatility. An approach that focuses on the statistical properties of daily price changes may or may not deem the market to be inefficient. A comparable argument could be made for price increases such as those shown in segment AB when the market moves above the equilibrium price for a sustained period of time.

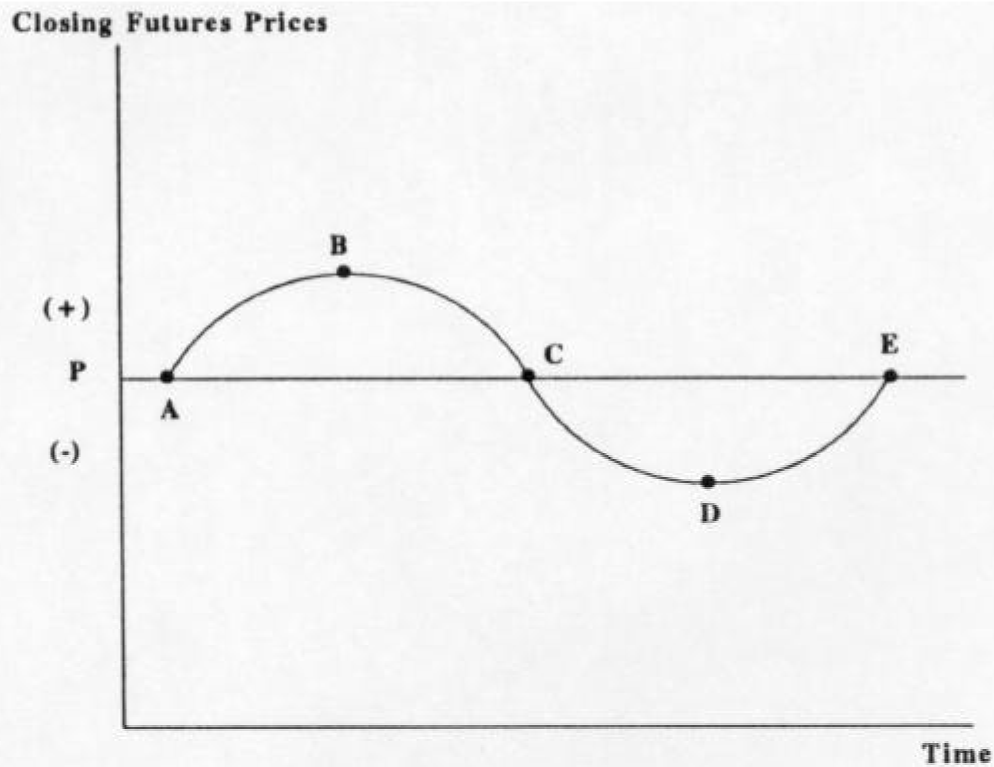

FIGURE 1
Conceptualization of departures in discovered prices from an underlying equilibrium price.

The implications to market efficiency research, to the futures exchanges, to regulatory agencies, and to users of futures markets are interesting and challenging. A market that moves below (or above) the implicit equilibrium price, the price that trade is seeking to discover, and stays there across a number of days can have significant implications to the underlying commodity sector and to the decision maker in that sector. An observer who knows little about the concept of market efficiency might, quite predictably, question how effective and efficient such a market really is in discovering price. A sustained price decline might abort developing supply responses, encourage selling of a storable product, or even prompt premature liquidation of breeding stock in the livestock sectors. There are important issues of allocative efficiency raised by such a pattern of market performance. Such issues are arguably especially important in agricultural commodities where information is provided largely via public reports, is subject to sampling error, and is often available only semi-annually (cattle inventory) or quarterly (13-state cattle on feed reports). These issues can be especially important in a specific sector such as cattle feeding where past research has shown that cattle feeders respond to changes in live cattle futures by changing placements of cattle on feed (Koontz and Purcell, 1988).

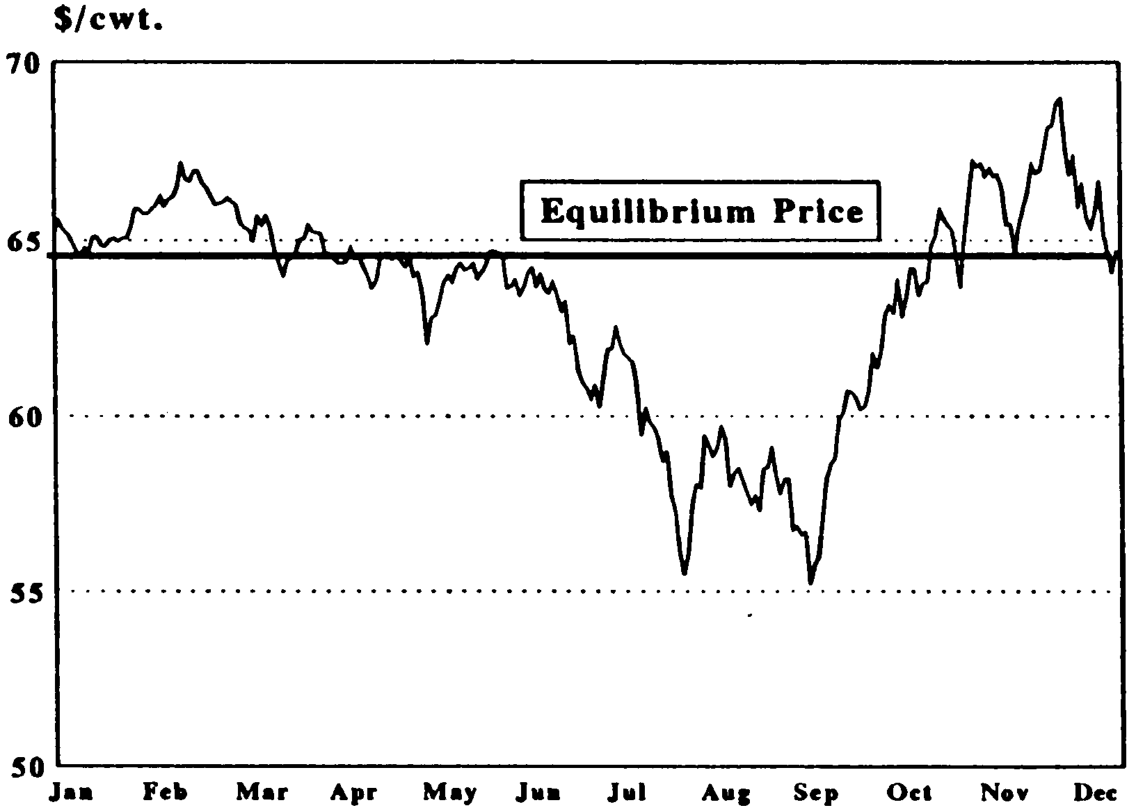

FIGURE 2
Daily closing prices for December 1985 live cattle futures.

Figure 2 provides a plot of the daily closing price for the December 1985 live cattle futures contract. The final closing price for the contract is used as an indicator of the underlying equilibrium price, the price equivalent to P in Figure 1. Prior to the maturing of the December futures, the equilibrium price as illustrated here by the final closing price was not known. Each day, the futures market was attempting to discover the correct price, the supply-demand balancing price, for December, 1985. The process of price discovery is not an exact science. Buyers and sellers bring their analysis of supply and demand to the marketplace and, based on their analysis, they formulate price expectations. The process involves less than full information about the future, and the associated risk and uncertainty is in fact why futures are traded. Departures from the underlying equilibrium price will occur because the information on supply and demand is not precise, is collected with sample error, will change from day to day, and is subject to interpretation by traders of varying analytical skills. It is the possible impact of differing trader mixes in the market that is of interest here.

In the December 1985 contract, there were clearly sustained departures from the final equilibrium price, especially to the downside, which raise the specter of supply response distortions. Supply response distortions, in turn, could cause more volatile prices to producers and to consumers than might otherwise be the case. During 1985, placements of cattle on feed in the seven major feeding states declined by as much as 17.9% (in July) compared to year-earlier levels, and placements were down more than 10% for four consecutive months, June through September.

Clearly, cattle feeders reacted strongly to the poor feeding margins that came with a December futures that approached the $55 level during the summer months. Cattle are in feedlots 120-180 days in typical feeding programs. By February, 1986, the implications of the reduced placements in the third quarter of 1985 were starting to become clear. Beef production in February, 1986 was over 16% below monthly levels for the previous August-October. Choice 600-700 pound beef carcasses that averaged $81.13 per hundredweight in quarter 3 of 1985 averaged a sharply higher $96.54 during quarter 4 of that same year, and averaged $88.04 during quarter I of 1986. Not all of this price change was felt by the consumer. Choice beef retail prices averaged $2.24 in August through October, 1985; $2.37 in December, 1985; and $2.37 in January, 1986. Prices for the first quarter of 1986 averaged $2.34. Much of the 19% increase in the carcass market during late 1985 was absorbed by reduced margins at the packer/processor and retail levels. The increase in retail prices from $2.24 to $2.37 was a more modest but significant 5.8%.

Garcia et al. (1988) analyzed the effectiveness of the live cattle futures as a predictor of the final price at which the contract matures. They concluded that the predictive accuracy of the market improved as the time horizon shortened to four months or less. Just and Rausser (1981) compared the predictive power of futures markets to econometric models and they also concluded the futures markets do better across a short-time horizon. Such findings are perhaps predictable. Across a time span of 180 days or less, the supply of cattle to come out of feedlots can be projected by using the weight groupings in the quarterly cattle on feed reports. Such data are based on sampling techniques and are measured with some error, but the magnitude of the error is generally considered to be 3% or less. In the presence of the generally accepted idea that the futures markets can start to focus in accurately on the final equilibrium price across a time horizon of 180 days or less, the pattern in Figure 2 offers a sharp contrast. In August and September, only three to four months before maturity of the contract, prices approached the $55 level. Around $55, the discovered price was nearly $10 below the final closing price and some $14 per hundredweight below the peak prices realized in late November and early December.

Price discovery for fed cattle is a complex process. Supply responses within the year are not only possible but probable. Changes in average slaughter weights of 5% or more are possible on a year-to-year basis, and a 5% increase in beef tonnage for a given slaughter level in number of head can prompt significant price changes even if demand is constant. Recognizing the complexity and the difficulty of the task, an important question still remains: Is the price pattern in Figure 2 indicative of an efficient market? If it is efficient in the context of uncorrelated day-to-day price changes, is it effective in an economic context in terms price discovery?

The December 1985 contract was selected because of the wide price swings and because it is contained in a uniquely available data set or traders' positions for the 1983-1987 period. But the December 198 contract is not unique. The continuation chart in Figure 3, comprise of trading activity of the nearby live cattle futures, suggests the wide swinging patterns have been prevalent across the years. Since 1985, the within-contract spread from high to low in December live cattle futures has ranged from near $9 in 1990 to $15 in 1987. A more recent yea 1992, recorded a low just above $67 and a high of $80, which is a $1 spread. In 1993, the low was $68. 10 and the high was $76.65 with the final closing price between $72 and $73. In only two of the years since 1985 has the price range in the September to December period bee less than $6 to $7 per hundredweight. In 1988, prices for the December 1988 live cattle futures were volatile early and then were largely confined to a $71-75 price range between September and contract maturity. 1 1993, the range during September to December was between $70.5 and $76.30. This type of volatility imposes a cost on everyone in the system from producer to consumer. Exposure to price risk carries a cost. Over time, middlemen tend to extract a bigger average margin to cover the costs associated with unstable margins brought on by variable input and/or output prices. Brorsen et al. (1985) document this tendency in flour milling, showing that operating margins increase as wheat prices become more volatile. Conceptually, the same behavior would be expected in the beef sector. In the short run, much of the ideconomic pain" might be passed back down to cattle producers in the form of lower (derived) prices for fed cattle. In the long run, of course, those lower prices will push some resources out of production, reduce beef supplies, and eventually result in higher prices to consumers.

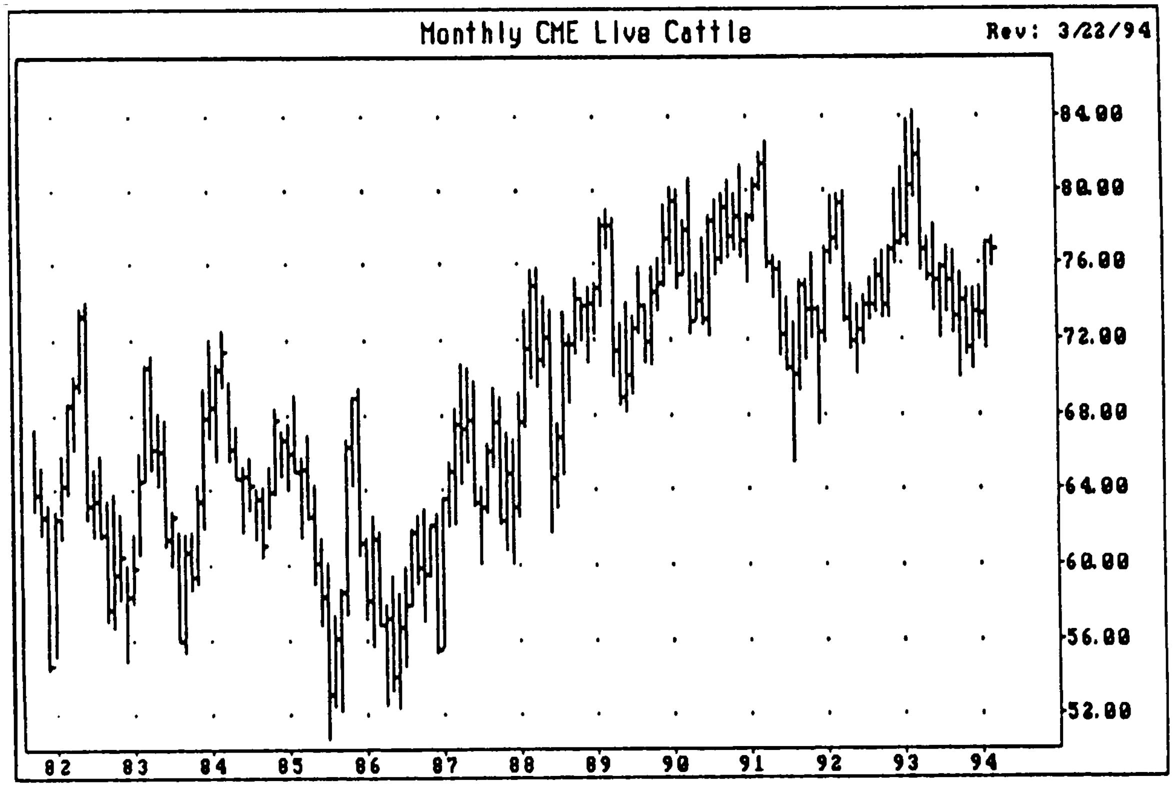

FIGURE 3
Continuation chart for nearby live cattle futures, 1982–1994.

If the amplitude and duration of the wide swings in the futures markets could be reduced, every participant in the system might benefit. Cattle feeders would face fewer scenarios where they are forced to either operate as cash market speculators or leave their pens empty and absorb the fixed costs of their investment while the market swings below the final equilibrium price for prolonged periods of time. Such an inference of benefits to cattle feeders could be debated since the market might also offer fewer significant departures from equilibrium on the high side, but evidence will be offered later to show that the markets seldom offer breakeven pricing opportunities during the month cattle are being placed. Packers would benefit from a more stable supply of fed cattle and more stable prices, changes which should stabilize margins and reduce their exposure to price risk on the procurement side. Consumers should see more stable and larger supplies of beef and more stable and lower prices over time.

There are a number of ways to reduce the amplitude and duration of the wide market swings. Better and more frequent information is one. Without question, increased sample size and more frequent release of public reports by the USDA would improve the quality and timeliness of the publicly available data base. Better educated and better trained market analysts is another. Changing the mix of trader could be another, perhaps more expedient, way to alter performanc of the markets. There is a constant dialogue on position limits, margin requirements, commissions, the advisability of dual trading, and relate dimensions that form the policy position of the exchanges and the CFT toward speculators, hedgers, and spread traders in the markets. Th mix of traders could be influenced by changes in policy at the future exchanges and at the CFTC. The objective of this research is to analyze the impact of different types of traders in live cattle futures on the price discovery process. Specifically, the analysis explores the behavior of large speculators and large hedgers around the turning points denoted by B and D in Figure I and the conceptually related extreme highs and lows in prices in Figure 2. Understanding the behavior of the different trading groups around the extremes and knowing which group is active and effective in "turning" the market back toward the still unknown but eventual equilibrium price should help the exchanges and the CFTC in formulating policies for hedgers and speculators, respectively, and it should also help researchers to better understand the dynamics of the price discovery process.

METHODOLOGY AND DATA

In 1998 the CFTC generated a unique data set for large traders (those holding 100 or more contracts) in live cattle futures. The data are coded by the CFTC to prevent identification of individual firms, but the broad classifications as hedgers (commercials) and speculators (noncommercials) are maintained. Daily closing prices, volume of trade, and open interest for all live cattle futures contracts traded during *1983-1987* were integrated into a data set that shows end-of-day positions for hedgers and speculators by groups.

Margins offered by the distant live cattle futures contract over variable costs are computed for the same *1983-1987* period. Feedlots are assumed to operate a four-month feeding program which involves feeding feeder steers weighing *750* pounds at placement to *1150* pounds at slaughter, and sold with a 4% shrink (i.e., pay weight of 1104 pounds). This scenario represents a typical Southern Plains (Texas, Oklahoma, New Mexico, and Kansas) custom cattle feeding program. The margin calculation is adapted from the procedure used by the USDA in its series *Livestock and Poultry Situation and Outlook.*

Margins (MAR) over variable costs on a per hundredweight basis are calculated weekly using the following formula:

MAR =[FLC4*11.04 – CAFC*7.5 – (CACORN*43 + CASM* 0.16 + CAHAY*1.0) – OVC – TB6MN*(Feeder Cattle and Feed Costs)]/11.04

MAR = Distant live cattle futures minus estimated variable costs of producing slaughter steers ($/cwt.);
FLC4 = Distant live cattle futures price for each Wednesday ($/cwt.);
CAFC = Weekly average feeder cattle price, 700-800 lb., M-1 steers, Amarillo ($/cwt.);
CACORN = Weekly average cash corn price, #2 yellow, Omaha ($/bu.);
CASM = Weekly average soybean meal price, 44%, Decatur ($/ton.);
CAHAY = Monthly average cash alfalfa hay cost, average price received by farmers in U.S., plus $30/ton handling and transportation expenses ($/head);
OVC = vet, death loss, marketing costs, transportation, etc. ($/head); and
TB6MN = U.S. Treasury Bills' yields on 6-month issue per annum M.

The margins over variable costs are used, as implied earlier, because there is excess capacity in the feedlot sector and, in the presence of excess capacity, economic theory suggests that feeder cattle prices will tend to be bid up to the point that the margins will approach zero and little or no contribution to overhead is being made. Figure 4 shows a plot of the feeding margins which were offered over the time period. The average margin was -$1.80 per hundredweight, with a minimum of -$8.18 and a maximum of $4.11 per hundredweight. The standard deviation was $2.48 per hundredweight.

Live cattle contracts on the Chicago Mercantile Exchange (CME) are traded for the months of February, April, June, August, October, and December. In calculating the margins, the pertinent futures contracts, by time of placement, are selected so that the cattle would always be sold prior to the closing dates of the particular futures contract. The relationships between the calculated margins and trader behavior, as evidenced by changes in open positions, are then analyzed.

Conceptually, large traders would be expected to react to what they perceive to be significant departures from an underlying equilibrium by changing their open positions. As positive margins get larger, long hedgers and speculators would be expected to reduce their open positions and short hedgers and speculators would be expected to add to their open positions. As expected margins become more positive, the rate at which open positions are changed is expected to increase. For increasingly negative margins, responses via changes in open positions are expected to increase and intensify as the margin grows more negative. Short hedgers and short speculators are expected to decrease open positions and long hedgers and long speculators are expected to increase their open positions. Table I shows how, theoretically, changes in positions by trader groups should be related to margin level and direction.

The hypothesis, therefore, is that the response of these large traders will intensify as the margins move farther away from the implicit equilibrium and that these responses are what turn the market back toward the underlying equilibrium. A sub-hypothesis is that large speculators, because they have no offsetting position in the cash markets, face stronger incentives to amass information and conduct effective analyses and will, therefore, be more important than hedgers in recognizing departures from an underlying equilibrium and in turning the markets.

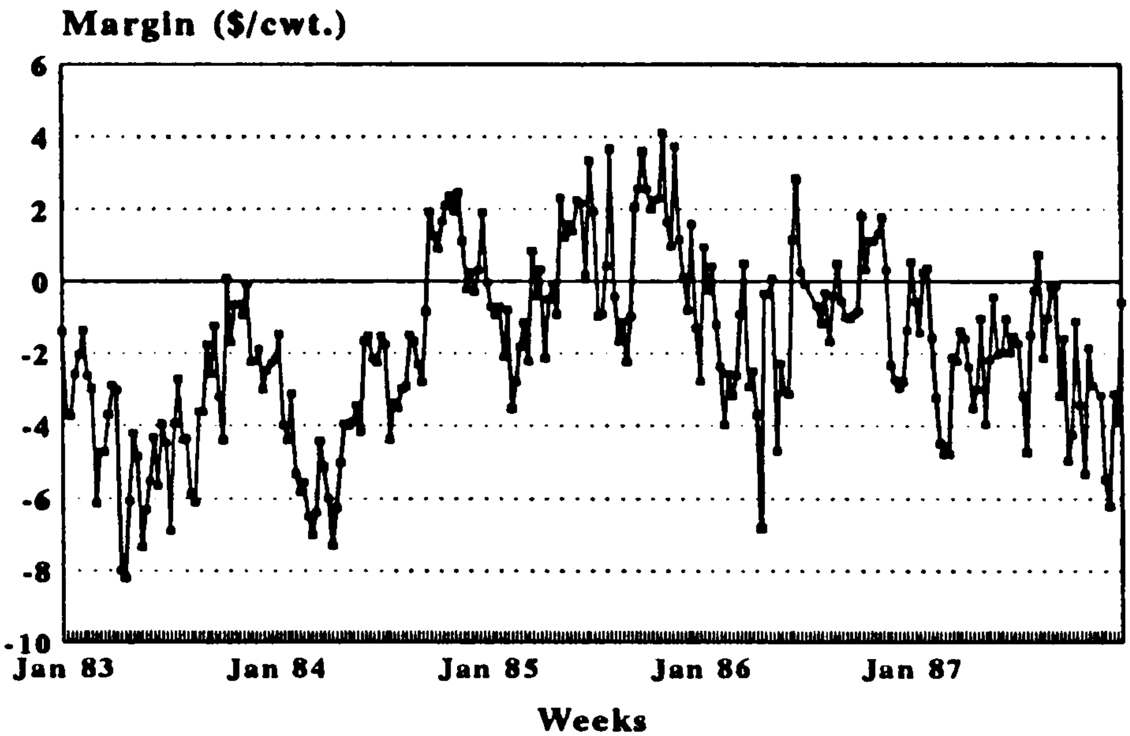

FIGURE 4
Average of the margin over variable costs offered by the closing price for appropriate distant live cattle futures, 1983–1987.

Table 1
Expected Signs of Estimated Beta Coefficients for Margins
Regressed on Changes in Trading Positions

		Trader Groups		
Margins	Long Hedge	Short Hedge	Long Spec.	Short Spec.
Positive/Increasing	(-)	(+)	(-)	(+)
Positive/Decreasing	(+)	(-)	(+)	(-)
Negative/Decreasing	(-)	(+)	(-)	(+)
Negative/Increasing	(+)	(-)	(+)	(-)

THE ANALYSIS

Correlation analysis is used to identify any relationship between trader behavior and the margins offered by the distant live cattle futures price. Lagged impacts of first differences in the margins are examined by analyzing correlations between changes (first differences) in trader positions from week *t* - 1 to week *t* and changes in margins calculated across time intervals up to 5 weeks, or week *t* - 5 to week *t*. Correlation analysis is used also to provide initial insight into the existence of a possible "trading range," around zero margin levels, within which no highly specific and consistent pattern of active trading behavior would be expected. Conceptually, speculators and hedgers would tend to wait to act until their price/margin expectations are significantly different from the margin being offered by the market before taking action, and neither group would be expected to be highly active around a zero-level margin.

The correlations suggest that changes in the large speculators' positions are statistically associated with changes in the margins being offered by the markets. When the margins are positive and increasing, both short hedgers and short speculators tend to reduce their positions. The correlations are -0.530 and -0.297 respectively (p = 0.05). Such actions tend to push the distant futures higher and increase the positive margins. But when the first differences in the positive margins turn negative as the market tops, long speculators reduce their positions by selling futures, which tends to move the margin back toward zero. Short speculators are also a factor. As the market turns and the still positive margins start to decline, the short speculators increase their positions.

When the margins are negative, the identifiable patterns of behavior are even more pronounced. So long as the margins are still decreasing, long speculators reduce their positions. Short speculators continue to increase their positions. Eventually, however, the margins reach some threshold and the speculators start to respond. The short speculators move aggressively to reduce their positions in association with increasing but still negative margins. The one-week time interval shows a correlation of -0.432 and a p-value of 0.0001. The correlation coefficients are relatively large (-0.366, -0.343, -0.211) for lags up to four weeks, and the p-values are quite small. Long speculators start to increase their positions, and the move back toward equilibrium is underway.

More analysis involving further disaggregation of the data set is necessary to start to identify the bounds of the conceptually established trading range around zero. The margin data are divided into $2 intervals within the broader division and put into positive and negative subsets. The range of the margin data is from -$8.18 to +$4.11 per hundredweight. For positive margins between $2.00 per hundredweight and the maximum $4.11, the correlations for short speculative activity in the same week and for a one-week lag are negative and statistically significant (p = 0.05). As the market tops and turns so that the first differences in margins are negative, short speculators add to their positions. Within the same week, short hedgers are also active.

In the $0-$2.00 interval, short hedgers are still active. Correlations are negative, which suggests hedgers add to their short positions as the market tops and moves back toward equilibrium. The short speculators are less active, a result that would be expected since the market is only marginally away from the underlying equilibrium and the speculators have different motives than hedgers. The correlation analysis suggests +$2.00 as a possible threshold or upper bound of a trading range around zero.

On the negative end of the continuum, long hedge position changes are negatively correlated with margin changes for the -$4.00-$6.00 interval. Long hedges are being established with further decreases in margins at those rather extreme negative levels. Short hedgers reduce positions in association with positive changes in the still negative margins below the -$6.00 level down to the minimum -$8.18 per hundredweight. But it appears to be speculators who play the most significant roles around the negative extremes. Short speculative positions are reduced in association with positive changes in the still-negative margins in the -$4.00-$6.00 range. Long speculators tend to buy futures aggressively in the -$4.00-$6.00 range as margins turn and start to increase. The correlations are negative and significant (p=0.05) across lagged time intervals up to three weeks.

Overall, the correlation analysis suggests that long hedgers establishing new positions, short hedgers covering existing positions, speculators starting to buy back short positions, and aggressive buying by long speculators turn the market at the extreme negative margins. Preliminary perceptions that -$3.00 approximates the lower bound o the implicit trading range around zero are reinforced by examination of the correlations for the -$3.00--$4.00 range in a data set with only $1.00 ranges in the margins. There are correlation coefficients in the -$3.00--$4.00 margin range with a p-value of less than 0.20 for activity by speculators, but none for margins between -$2.00 and -$3.00. Below -$4.00, both speculators and hedgers are involved in turning the market and the significance levels are at 0.05 or smaller.

A regression model is specified to explain the variation in the expected margins being offered by live cattle futures. The general model is: [1]

CHMAR = *f* (CHLONGH, CHSHORTH, CHLONGS, CHSHORTS)

where

CHMAR = The weekly first difference in expected margins above variable costs offered by distant live cattle futures prices ($ per cwt.);

CHLONGH = The first difference in total long hedge positions held by large traders for all live cattle futures contracts traded each Wednesday (actual positions);

CHSHORTH = The first difference in total short hedge positions held by large traders for all live cattle futures contracts traded each Wednesday (actual positions);

CHLONGS = The first difference in total long speculative position held by large traders for all live cattle futures contracts traded each Wednesday (actual positions); and

CHSHORTS = The first difference in total short speculative positions held by large traders for all live cattle futures contracts traded each Wednesday (actual positions).

Drawing on the results of the correlation analysis, the complete data set is decomposed into two subsets which identify thresholds of activity and which represent an upper and a lower end of a trading range. In establishing possible trading ranges, the following criteria are used:

1 Extensive tests are conducted for normality, homoskedasticity, parameter stability, autocorrelation, and functional form to ensure validity of the assumptions underlying the regression model. There are no significant problems. More detail on the tests and their findings are available from the authors.

(1) expected margins are outside of a range (-$3.00 to $2.00) within which there are few if any statistically significant ($p = 0.05$) correlations between CHMAR and changes in various trader positions; and (2) expected margins outside of a range (-$4.28 to $0.67) are formed by using one standard deviation of the mean of the margins.

The final model specification includes a lag of the dependent variable, with the lagged variable labeled LGCHMAR (Table 11). Including a lag of the dependent model is necessary to eliminate serial correlation in

TABLE 11

Changes in Expected Margin Regressed on Changes in Trader Positions over Subsets of the Margin Data

Dependent Variable: Change in Expected Margin (CHMAR)

	All	*All Positive*	*Positive/ Increasing*	*Positive/ Decreasing*	*All Negative*	*Negative/ Increasing*	*Negative/ Decreasing*
Constant	0.3393	0.64728	1.55208	-0.93685	-0.15959	0.95247	-1.11341
	(0.359)[a]	(2.871)	(6.930)	(-4.024)	(-1.531)	(7.926)	(-9.355)
Lagged CHMAR (LGCHMAR)	-0.26206	-0.20011	-0.03154	-0.16054	-0.32336	-0.21193	-0.09614
	(-4.351)	(-1.467)	(-0.226)	(-1.376)	(-4.943)	(-2.737)	(-1.467)
Change in Long Hedging Positions (CHLONGH)	0.00016	0.00025	0.0002	0.00005	0.00011	0.000046	0.00013
	(2.297)	(1.875)	(0.150)	(0.407)	(1.365)	(0.525)	(1.580)
Change in Short Hedging Positions (CHSHORTH)	-0.00019	-0.00040	-0.00029	-0.00018	-0.00008	0.000046	-0.00004
	(-3.105)	(-3.551)	(-2.978)	(-1.187)	(-1.205)	(0.633)	0.611)
Change in Long Speculative Positions (CHLONGS)	0.00027	0.00028	0.00006	0.00016	0.00021	-0.000042	0.00015
	(5.312)	(2.157)	(0.566)	(1.053)	(3.806)	(-0.639)	(2.677)
Change in Short Speculative Positions (CHSHORTS)	-0.00039	-0.00021	-0.00019	-0.00009	-0.00045	-0.00023	-0.00019
	(-4.878)	(-1.284)	(-1.280)	(-0.463)	(-5.038)	(-2.587)	(-1.847)
					Regression Statistics		
F-Value	14.465	4.368	3.104	0.970	12.285	2.359	2.880
P-Value for F	0.0001	0.0021	0.0210	0.4712	0.0001	0.0479	0.0185
Adjusted R^2	0.221	0.228	0.216	-0.008	0.239	0.076	0.089
Degrees of Freedom	237.000	57.000	38.000	18.000	179.000	82.000	96.000

[a]Numbers in parentheses are t-ratios.

and short speculative positions are both forces in bringing decreases in the still positive margins and in moving the market back toward equilibrium. The positive/decreasing subset is a relatively small data set and the coefficient estimates are not statistically significant. Only the coefficient on CHSHORTH has a t-ratio greater than 1.0 and the regression in its entirety is not significant.

For positive margins, then, when the market is moving out of balance to extreme levels, the results in Table 11 do not identify clearly what type of trader turns the market. The evidence is mixed, perhaps because the level of aggregation in the data is still relatively high. There is limited evidence that short hedgers move the market back toward equilibrium after the market has topped and margins start to decrease, but the coefficient on CHSHORTH is not statistically significant at widely accepted p-levels.

The patterns of behavior for the negative margins appear to be more clear at this level of aggregation. As the negative margins decrease toward extreme levels, long speculators decrease their positions given the positive and highly significant ($p = 0.05$) coefficient of 0.00015. Long hedgers do the same, but the coefficient estimate is much less significant in a statistical sense with a t-ratio of 1.580. Such liquidation involves selling to cover long positions and tends to push the market lower toward the negative and implicit threshold level. Short speculators are still adding to their positions, and the t-ratio of - 1.847 would be statistically significant at the 0.10 level.

Eventually, however, a threshold is reached, the futures market prices bottom, and the margins turn higher. Buying by short speculators to liquidate short positions appears to be the dominant behavioral pattern for the negative/increasing margins. The coefficient of -0.00023 is relatively large and is statistically significant ($p = 0.05$). There is no evidence that hedgers are active in turning the market back toward the zero-base equilibrium margin. At the negative extremes, therefore, it appears that large speculators are the dominant force in the correction process.

The level of aggregation appears to be complicating the analysis, so the data set is analyzed for sub-samples corresponding to upper and lower thresholds that define a trading range around zero. As noted earlier, two criteria are used to generate data subsets. First, sub-samples are selected based on the results of the correlation analysis. There is some basis for upper and lower ranges from $2.00 per cwt. to the maximum value of the margin ($4.11) and from -$3.00 per cwt. to the minimum value of the margin (-$8.18). At above $2.00 both hedgers and speculators are associated with moves by the margins back toward zero. Speculators show statistically significant reactions to negative margins from -$3.00 to the minimum level, and hedgers are involved also for the levels below -$4.00. The second criterion for selection is the range outside of a 68% confidence interval of the mean margin. The 68% confidence level generates upper and lower segments from $0.67 per cwt. to the maximum margin and from -$4.28 per cwt. to the minimum margin.

The coefficient estimates from the models for the margin ranges are reported in Table Ill. In the $2.00-to-maximum range, short speculators and short hedgers exert an influence on the market after it tops and turns. The negative coefficients on CHSHORTH and CHSHORTS indicate both hedgers and speculators are selling the market as the margins turn back toward zero baseline. The coefficient on CHSHORTS is larger in absolute value than the one on CHSHORTH, and the significance level is stronger ($p = 0.05$) than for short hedgers ($p = 0.10$), suggesting that short speculators are important in turning the market. This involvement by short speculators is not apparent when the analysis is restricted to only positive/increasing and positive/decreasing data subsets. For data in this range, the unadjusted $R2$ is 0.513, a large level for the relatively small data set of differenced data. These results serve to confirm the hypothesis that speculative behavior is very important in turning the markets and starting the process of restoring an equilibrium in price. They also tend to confirm the a priori expectation that no definitive patterns of behavior are found at or close to the underlying equilibrium.

Empirically, it is possible to determine exactly *when* the trading groups change their positions. When margins are positive and increasing, a negative coefficient on CHSHORTS suggests decreases in short speculative positions push the margins higher. As the market tops and the changes in the still positive margins turn negative, the negative coefficient on CHSHORTS then indicates increases in short positions are pushing the margins lower toward zero. The results suggest that both hedgers and speculators move to take new positions or offset established positions as the market moves beyond some threshold they identify for placing hedges or acting on a speculative investment program. Obviously, the exact location of this threshold varies among traders, but the implied frequency of these trader-specific thresholds tends to increase as the market moves farther from equilibrium.

In the -$3.00-to-minimum range, speculative activity appears to dominate the correction process. The positive and highly significant

TABLE III
Changes in Margins Regressed on Changes in Positions over Upper and Lower Ranges of the Margin

Dependent	Change in Expected Margin (CHEXPM)		
Criterion (1): Upper Range $2 to Max.	Criterion (1): Lower Range Min. to −$3	Criterion (2): Upper Range $0.67 to Max.	Criterion (2): Lower Range Min. to −$4.28
Constant			
1.32751	−0.38055	0.81441	−0.60763
(3.943)[a]	(−2.050)	(2.918)	(−2.080)
Lagged CHMAR (LGCHMAR)			
−0.04851	−0.20771	−0.22653	−0.19364
(−0.231)	(−1.745)	(−1.337)	(−0.969)
Change in Long Hedging Positions (CHLONGH)			
0.00017	−0.00007	0.00026	−0.00007
(0.945)	(−0.486)	(1.376)	(−0.307)
Change in Short Hedging Positions (CHSHORTH)			
−0.00030	−0.00009	−0.00036	0.00001
(−1.962)	(−0.923)	(−2.864)	(0.090)
Change in Long Speculative Positions (CHSLONGS)			
0.00020	0.00027	0.00023	0.00030
(0.845)	(3.218)	(1.473)	(2.257)
Change in Short Speculative Positions (CHSHORTS)			
−0.00061	−0.00027	−0.00026	−0.00011
(−2.461)	(−1.725)	(−1.230)	(−0.458)
Regression Statistics			
F-Value			
2.530	4.466	3.123	1.851
P-Value for *F*			
0.0871	0.0015	0.0196	0.1292
R^2			
0.513	0.255	0.308	0.213
Adjusted R^2			
0.310	0.198	0.209	0.098
Degrees of Freedom			
17.000	70.000	40.000	39.000

[a]Numbers in parentheses are *t*-ratios.

coefficient ($p = 0.01$) on CHLONGS confirms that long speculators are active in buying the market and pushing the margin back up toward zero. Short speculators buy to liquidate short positions ($p = 0.10$), and the open short speculative positions decrease as the negative margins start to increase. Neither the long nor the short hedgers are significant factors near the extreme negative margins. The *t*-ratios for both groups are below 1.0 in absolute value.

For the $0.67-to-maximum range, the signs are generally consistent but the statistical significance varies compared with the $2.00-to-maximum range. Short speculators are relative less important and short hedgers are relatively more important in this broader price range. Hedgers might be more inclined to sell the market on those brief surges that carry the margin just above zero, to perhaps $1.00, than would the speculator. The speculator is looking for profit, not price risk-management, and a market that appears to be $1.00 from an estimated equilibrium is less attractive than a market that is $3.00-$4.00 from that equilibrium.

The -$4.28-to-minimum range identified by the 68% confidence interval shows results very similar to the - $ 3.00-to-minimum range. The coefficient on CHLONGS is the only significant coefficient (p - 0.05), and it is positive and relatively large at 0.00030. Long speculators buy the extremes and are present as a force in moving the feeding margins back up toward zero.

CONCLUSIONS AND IMPLICATIONS

The primary conclusion drawn from the results reported herein is that actions by hedgers combined with arbitrage and profit motivated activity by speculators will eventually correct market imbalances. Regression models to explain margins being offered by futures prices as a function of trader behavior confirm this conclusion. When the feeding margins being offered are unusually positive or negative, both trader involvement and intensity of actions increase. Speculative activity in particular becomes intense and exerts a constraining influence on the futures prices and on the feeding margins being offered by the futures prices, and turns the market back toward a zero-level equilibrium. These results confirm the primary hypothesis that actions to change the number of open positions will intensify and increase as the market moves farther from equilibrium.

The analysis also indicates that speculative activity is somewhat more sensitive to the margin changes when negative margins are present than when positive margins are being offered. For hedgers, the opposite result prevails. When the markets cannot provide producers with profits via short hedges, cattle feeders operating as hedgers are, by definition, not involved in the price discovery process. Producers are being forced to speculate in the corresponding cash markets and only the historically limited participation of packers as long hedgers might be involved. Speculators eventually turn the negative margins back toward zero, but only after risk/reward thresholds are met at margin levels that might be economically damaging to the cattle feeder, other cash connected interests in the production-marketing system, and ultimately to consumers. The results of the analyses provide confirmation of the sub-hypothesis, that large speculators are more important than hedgers in turning the market back toward equilibrium. This hypothesis is more strongly confirmed for extreme low prices and negative margins than for the extreme high prices and related positive margins.

The policy implications of the results are many and diverse. A large body of literature, suggests that futures markets, to be viable and effective, need a balance between hedging and speculation. In the live cattle futures, the continued absence of significant long hedgers is the basis of much criticism. It is argued that the market will be biased downward if the long speculator has to buy the short positions offered by the short hedger and that a risk premium will have to be present to entice the long speculator into the market. For years, there has been much debate on how to attract the long hedger to the market. One of the motivations for the creation of the certificate system of delivery in the early 1980s was to make the situation better for the potential long hedger. Changes in contract delivery provision in 1994, effective for the June 1995 contract, are also at least partly motivated by the desire to see more long hedgers involved. However, the results of this analysis suggest that if avoiding prolonged departures from an underlying equilibrium is a desired end result, then policies to encourage participation by the large speculators might be more appropriate. It is the large speculator that is active in recognizing a disequilibrium situation and turning the market back toward equilibrium, and their activities are especially important when the futures price being discovered is offering only large negative feeding margins.

The findings will, therefore, be important to discussions on policies regarding speculators. Position limits, liquidation schedules, and any other policy issue that influences participation by the large speculator should be discussed with full awareness of how important this group of traders is to price discovery and to broad gauges of market effectiveness in live cattle futures.

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