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An Analysis of Trader Activity During Limit-Move Events in Live Cattle Futures

by

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Price limits in futures markets can inhibit discovery of the market-clearing equilibrium price. This study examines the price discovery contribution of six broad groups of traders during limit-move events in live cattle futures. A quantitative measure of the daily net price pressure exerted by each trader group was developed and used to identify trader activity on and around limit moves. Results indicate that, overall, limit moves are more likely to improve price discovery than to hurt it. Positive limit moves strongly enhance price discovery while negative limit moves tend be more harmful. A group composed of commodity pool and commission house traders were best at anticipating limit moves while large speculators were more likely to have a hand in causing them. No trader group consistently outperformed the others in exerting pressure beneficial to the price discovery process during limit-move events.

Introduction

Price discovery is the process by which buyers and sellers arrive at the appropriate price given the underlying forces of supply and demand in a commodity market. In cash markets, the price discovery process is repeated for each item of the physical commodity that changes ownership. In futures markets, however, where each contract is identical, the price discovery process can be viewed as beginning with the first trade in a listed contract and continuing until contract maturity. In essence, the futures market spends months trying to discover the maturity-date supply-demand balancing value of the commodity called for by the contract.

A number of previous authors have found futures markets to be important centers of price discovery for agricultural products (Oellermann, Brorsen and Farris; Hudson and Purcell; Garbade and Silber). When futures markets perform the price discovery function well, prices generated in these markets will be accurate reflections of the true maturity-date value of the commodity. Since producers and users of a commodity can use futures prices to guide production and consumption decisions, markets that do a good job of price discovery generate social benefits in the form of improved resource allocation (Stein).

Limits on the size of price movements are a unique characteristic of futures markets. Nearly all futures contracts for agricultural products traded in the U.S. specify some maximum permissible movement in price from the previous day's settlement price. Since constraints on price movement can prevent a market from reaching the equilibrium price, these limits impact one of the most important functions of futures markets—price discovery.

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Undoubtedly, limit moves are the result of a dramatic re-assessment of price expectations by a large number of traders. This may be precipitated by the release of unanticipated public information or by developments such as disease, weather or other natural phenomena. If limit-move events occur because of an improved assessment of future supply and demand conditions, then limit-move events are beneficial to the price discovery process. On the other hand, limit moves caused by reactionary or crowd-following (herding) behavior by traders may harm price discovery. Knowledge of the price discovery effects of limit moves and the influence of particular types of traders during these events can be useful to exchanges in developing policy on price limits.

Since different types of traders develop information from different sources, it is possible that the behavior of some traders leads to limit moves more frequently than other types of traders. Such situations may provide an indication of the relative value of different traders to the price discovery process.

This paper analyzes the trading activity of different types of traders in live cattle futures on and around limit-move events. Initially, the trading behavior of each group of traders is translated into a measure of the amount of pressure each exerts daily on futures prices. By examining these price pressure measures on limit-move days and the days surrounding limit moves, it is possible to ascertain if any particular group of traders is more likely than others to be responsible for limit-move events, or if any particular group of traders is more likely than others to anticipate limit moves. Further, limit moves themselves are examined to determine if these events are beneficial or harmful to price discovery.

Data

This study made use of data obtained from the Commodity Futures Trading Commission's (CFTC) reporting trader data base. All traders holding overnight live cattle futures positions greater than 99 contracts must report those positions to the CFTC daily. This data is used for surveillance purposes and also forms the basis for the *Commitment of Traders* report published bi-monthly by the CFTC.

The specific portion of the CFTC reporting data utilized in this work was that for individual accounts trading the Chicago Mercantile Exchange's (CME) live cattle futures contract beginning with the December 1983 contract and extending through the October 1987 contract. Accounts were coded to conceal the identity of individual traders, but information revealing the commercial classification of the position and the general type of trader holding the position was included.

Several trader groups were identified from the CFTC data. First, all accounts that were not individual customer accounts were put together in one group. These included accounts of commodity pool operators, accounts used for the program trades of commodity futures merchants, and house accounts. For reference purposes, this group is labeled the "funds/other trader" group. Next, accounts for which all positions were commercial were grouped together. Frequently these traders are referred to as hedgers, but for the purposes of this research it is sufficient to simply note that the owners of these accounts hold a cash position related to the cattle or beef trade. Similarly, accounts for which all positions were noncommercial (i.e., speculative) were placed together in one group.

A number of accounts in the CFTC data base had some mixture of commercial and noncommercial reportable positions over the period examined in this study. Time series of the positions of these accounts were examined for clues to aid in classifying these accounts as either primarily commercial or noncommercial. In the end, most of these mixed accounts showed a greater predisposition toward commercial activity and were included in the commercial group. Only three of these mixed accounts were eventually classified as noncommercial.

To further distinguish between trader types, the commercial and noncommercial groups were subdivided based on trader size. The average open position for each class of traders was calculated and used as a dividing point. Accounts with average open positions less than the overall group mean were designated as medium commercial or medium noncommercial, and accounts with average open positions greater than the mean were designated as large commercial or large noncommercial traders.

Thus, all accounts in the CFTC reporting trader data base were classified into one of five groups: large commercials (149 accounts), medium commercials (228 accounts), large noncommercials (285 accounts), medium noncommercials (386 accounts), and funds/other traders (137 accounts). In addition, the net position of all the remaining traders in the live cattle futures market (those not required to report to the CFTC) could be calculated as the positions required to balance the net position of all the reporting traders. This residual group of nonreporting traders is labeled the "small trader" group.

Once all of the accounts were coded to reflect their proper group membership, the individual account data were aggregated to produce a net position for each trader group on each day in each individual futures contract. Short positions were indicated with negative numbers and long positions with positive numbers. Daily settlement price and price change data were then added to the aggregated data set.

Price Pressure Measurement

To aid in determining how various types of traders are affected by, and which trader groups are responsible for, limit moves, a daily measure of the amount of pressure each group exerts on price is useful. The concept of price pressure is one that is frequently employed by market analysts. They often cite certain types of traders for displaying "significant downward pressure" or "slight buying pressure" in futures markets. Although these qualitative references to price pressure are common, quantitative measurement of price pressure by different groups of traders has not been widely attempted.

In this study, an empirical measure of the daily price pressure exerted by each of the six trader groups was constructed. The process begins with calculation of the first differences of the trader group net position data. Changes in a trader group's net position from day to day provides an indication of changes in the group's collective price expectation. If a trader group has a positive net position change (the traders, as a group, have become more long or less short) on a particular trading day, this would indicate an upward revision in price expectations.

A fraction is calculated which indicates the percentage of new net positions for the day attributable to each of the trader groups. These are referred to as initial fractions and calculated as:

$$I_{it} = \frac{\Delta NP_{it}}{\sum_i |\Delta NP_{it}|} \tag{1}$$

Here, I = initial fraction, ΔNP = the change in net position, i indicates trader group, and t represents the trading day. The denominator is the total new net positions for day t (absolute values are used in the sum to prevent canceling by positive and negative net position changes). The initial fractions are used to allocate the daily price change (ΔP) among the six trader groups and thus producing an initial measure of price pressure, IP, where $IP_{it} = I_{it} \cdot |\Delta P|$. By construction, the initial price pressure measures always sum to zero.

Very seldom is there no change in the futures price from day to day. When there is a nonzero price movement, one or more trader groups must have exerted some additional pressure on price that resulted in the observed movement. On days when price moves up (down) from the previous settle, it must be the case that those trader groups that were net buyers (sellers) exerted the additional pressure. The next step in price pressure calculation involves dividing ΔP among only those trader groups that had net position changes corresponding to the direction of the price change. These groups are referred to as "mover groups". For example, if the direction of the price change is up, the mover groups for that observation are those possessing positive (more long/less short) net position changes. Supplemental fractions are used to facilitate this step of the calculation. The supplemental fractions (S_{it}) can be represented by:

$$S_{it} = \frac{\Delta NP_{it}}{\sum_i |\Delta NP_{it}|} \quad \forall\, i \in \text{mover groups} \tag{2}$$

Supplemental fractions for non-mover groups are zero. As with the initial pressure calculation, the supplemental fractions are used to calculate a supplemental price pressure (SP) according to $SP_{it} = S_{it} \cdot |\Delta P|$. Finally, the initial and supplemental price pressures are summed to produce a total price pressure measure for each trader group.

An important characteristic of the price pressures is that when they are summed across trader groups for any particular trading day, they yield the exact price change for that day. This says the daily change in the futures price is completely described by the price pressure exerted by all of the players in the market. This process was used to calculate historical price pressures for each trader group on each trading day in the data set.

Isolating Trader Activity During Limit-Move Events

To facilitate the study of trader group behavior during limit-move events, the price pressures of each trader group were isolated for the day preceding, the day following and the day of each limit-move event. A limit-move event was defined to be any trading session where trading was essentially halted, and the session closed with a price change equal to the daily permissible limit (± \$1.50 /cwt.). These are situations where the price limit prevented the market from reaching an equilibrium settlement price. If the market closed limit up or limit down on consecutive days, then all such days were considered to be part of the same limit-move event.

In other words, a limit-move event was considered ended when price was allowed to settle at a non-constrained equilibrium.

There were a total of 123 limit-move events that occurred in live cattle futures during trading of the 24 contracts beginning with the December 1983 contract and ending with the October 1987 contract. Fifty-seven (46.3%) of these events were positive limit moves and 66 (53.7%) were negative limit moves.

Trader Group Influence During Limit Moves

The behavior of trader groups, in terms of the pressure they exert on price, on and around limit-move days provides an indication of the relative influence of each trader type during these events. The first question to be answered is whether or not the price pressure delivered during limit-move events is substantially different from price pressure delivered on non-event trading days. To test this, the mean price pressure for each trader group on days before, during and after limit moves was calculated and compared to the mean price pressure over the entire four year period of the analysis. Table 1 presents t-statistics for the following hypothesis tests:

$$H_0: \bar{P}_{i,LM} = \bar{P}_i$$
$$H_1: \bar{P}_{i,LM} \neq \bar{P}_i \ . \qquad (3)$$

Here, $\bar{P}_{i,LM}$ is the average price pressure of trader group i during limit-move events and $\bar{P}_i$ is the average price pressure for group i over the entire sample period. Negative t-statistics indicate that the average price pressure during limit-move events was "more downward" than the average price pressure observed during the entire period. It is important to recognize that negative price pressures do not necessarily signal smaller amounts of pressure; they indicate pressure in the opposite direction (selling pressure) from positive pressures.

The Table 1 results indicate significant price pressure differences for all trader groups on the days preceding and following limit moves. Both positive and negative differences are observed. On the actual limit-move day, however, three trader groups, both of the noncommercial groups and the funds/other group do not display price pressure that is significantly different from that which they exert during non-limit move trading days.

These results seem to suggest that for all trader groups, limit-move events are periods of unusual trading activity when all three days are taken into account. One explanation for the lack of significant price pressure differences by three groups on the actual limit-move day may be that they were slow to recognize the market-moving action and were thus "limit-locked" out and unable to participate in the move. Another explanation could be that these three groups were able to correctly anticipate the event and adjust their positions prior to it so that no further unusual price pressure occurred for those groups on the actual day of the event. Further analysis will help to distinguish between these two possible explanations.

Price pressure measurements can also provide an indication of which groups, if any, anticipated, caused or were constrained by limit moves. This can be determined by noting whether the price pressure exerted by a trader group on a particular day was consistent with, or agreed with, the direction of the limit move. For example, if a trader group tends to show a propensity to exert positive price pressure on the day before an upward limit move, then this suggests that this group, was, to some degree, able to *correctly anticipate* the limit move. If a

Table 1. T-statistics From Tests of Differences in Mean Price Pressure Over All Trading Days in the Sample with Mean Price Pressure on Limit Move and Adjacent Trading Days.

	Day of Limit Move	Day Before Limit Move	Day After Limit Move
Trader Group:	T-statistic for H_0: Limit Move Mean = Entire Sample Mean.		
Large Commercial	-17.98*	-30.50*	-9.20*
Medium Commercial	-27.76*	21.08*	108.60*
Large Noncommercial	-0.47	-35.86*	34.15*
Med. Noncommercial	-0.94	20.84*	11.67*
Funds/Other Traders	0.42	8.31*	-3.99*
Small Traders	3.82*	19.24*	16.43*

*Significant at α=.01.

group consistently exerts pressure in the same direction of the limit move on the day that it occurs, then this provides evidence that the group regularly helps *cause* limit-move events. Finally, if a group exhibits price pressure in the same direction of the limit move on the day following, this suggests that they were *constrained* by the price limit and were unable to exert fully the pressure they desired on the day of the event.

Consistency in direction between trader group price pressure and limit-move events is a Bernoulli variable. The variable takes the value of unity if the price pressure and limit move are in the same direction and a value of zero if not. A Bernoulli variable is distributed as follows:

$$f(x;p) = \begin{cases} p^x(1-p)^{1-x} & \text{for } x = 0,1 \\ 0 & \text{otherwise} \end{cases} \tag{4}$$

where:

x = random variable, 0 or 1, and
p = parameter representing the probability that X takes the value 1 (a "success").

Given a set of data realizations of x, the likelihood function (L) for the parameter p is:

$$L \propto p^{\sum_i x_i}(1-p)^{\sum_i (1-x_i)}. \tag{5}$$

The log likelihood function is:

$$\ln L = c + \sum_i x_i \ln(p) + \sum_i (1-x_i)\ln(1-p) \tag{6}$$

where c is a constant of proportionality. Setting the first derivative of **(6)** equal to zero allows derivation of $\hat{p}$, the maximum likelihood estimator of the unknown population parameter, p.

$$\hat{p} = \frac{1}{N}\sum_i x_i \,. \qquad \textbf{(7)}$$

The asymptotic distribution of this estimator is embedded in (Spanos):

$$\sqrt{T}(\hat{p} - p) \sim N(0\,,p(1 - p)) \qquad \textbf{(8)}$$

If there were no systematic tendency for a trader group to exert price pressure in the same direction of the limit move, we would expect the value of p to be 0.5. That is, if agreement between group price pressure and limit move direction were completely random, then we could expect them to agree 50 percent of the time simply because of chance. Knowledge of the asymptotic distribution of the estimator permits testing for values of p that differ significantly from 0.5.

Each limit-move event was compared pair-wise with the price pressure of each trader group for agreement in direction. When a trader group exerted zero price pressure, that observation was not counted since in those instances the price pressure neither agreed or disagreed with the limit move, which by definition had to be either positive or negative. Table 2 presents the number of agreements and disagreements between the direction of the limit move and each trader group's price pressure on the day preceding, the day of, and the day after the event. The following hypothesis was tested:

$$H_0: p = 0.5$$
$$H_1: p \neq 0.5 \quad . \qquad \textbf{(9)}$$

P-values give the percentage of the distribution beyond the calculated test statistic and indicate the strength of belief in the null hypothesis (with smaller P-values being stronger evidence in favor of rejecting the null hypothesis).

With respect to price pressure on the day preceding a limit move, the Table 2 results indicate that the null hypothesis can only be strongly rejected for the funds/other trader group. This is the only group that appears to have a better-than-average ability to correctly anticipate limit-move events.

On the day of the limit move, the large noncommercial group shows a strong tendency toward limit-move-promoting price pressure. The small trader group is the only group that displays a significant tendency toward limit-move-restricting pressure. Either the small traders interpret the new incoming information differently from other traders or they are slower in receiving the signal.

On days following limit moves, two groups, the medium noncommercial and the funds/other trader group have significant disposition toward price pressure in the same direction as the preceding day's limit move. Price limits apparently are more likely to restrain these trader types than the others. Three other groups, both of the commercial groups and the small trader group, exhibit price pressure contrary to the direction of the limit move on the day following.

Table 2. Number of Observations Where Price Pressure Direction Agreed or Disagreed with the Direction of the Limit Move and P-values for Tests of Differences Between the Two.

	Number Agreeing[a]	Number Disagreeing	P-value
Day Preceding Limit Move:			
Large Commercial	48	54	0.235
Medium Commercial	41	35	0.169
Large Noncommercial	53	47	0.230
Medium Noncommercial	22	28	0.090
Funds/Other Traders	51	39	0.011
Small Traders	59	53	0.257
Day of Limit Move:			
Large Commercial	55	53	0.700
Medium Commercial	46	46	1.000
Large Noncommercial	68	44	0.000
Medium Noncommercial	33	34	0.807
Funds/Other Traders	50	50	1.000
Small Traders	56	66	0.070
Day Following Limit Move:			
Large Commercial	46	59	0.011
Medium Commercial	33	47	0.002
Large Noncommercial	54	48	0.235
Medium Noncommercial	37	21	0.000
Funds/Other Traders	58	35	0.000
Small Traders	49	66	0.002

[a]Number agreeing and number disagreeing do not add up to the total number of limit moves (123) because observations where a group exerted a pressure of zero are omitted.